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LOWER PORTION OF SPINNING ROOM SHOWN BELOW. OBSERVE ARRANGEMENT OF LOWER PART OF MACHINES. COMPLETED SPOOLS OF TWINE ALSO APPEAR.

UPPER PART OF SPINNING MACHINES, IN SPINNING ROOM, SHOWING NIPPER WHEEL, FEEDERS AND GRASS CONVEYOR CONTAINING GRASS THAT IS DISTRIBUTED TO THE MACHINES.

MACHINES FOR CONVERTING WIRE GRASS INTO TWINE.

WIRE GRASS—A NEW INDUSTRY.

IN the last few years an entirely new industry has sprung up in the West; we refer to the utilization of wire grass, which is generally recognized by the botanist as *Carex stricta*. It differs from the true grasses, among other characteristics, in having a stem without a joint. It has no lateral leaves; the round blades grow up straight from the roots to an average height of three or four feet, forming one continuous fiber. The true grasses, on the other hand, have hollow columns or stems with joints and lateral leaves. Wire grass is almost entirely devoid of mineral substances, as it grows in peat and bog marshes where there is a marked absence of mineral qualities. Besides being deficient in lime and potash, it is also poor in nitrogen. The small content of these substances compared to other grasses keeps the wire grass pithy and tough and preserves its pliability indefinitely. The plant requires plenty of water and grows best when the temperature is high. In its well-developed form, wire grass grows only in marshes or bogs where there is an abundance of heat. These marshes occur most extensively in the great glacial belt extending from the Ohio River far into the British Northwest. The peat varies from 1 to 20 feet in depth. Comparatively few of these vast areas have been perfectly surveyed, but a general investigation shows there are fully a million acres of wild grass marshes scattered through the States of Minnesota and Wisconsin. Not only is the present area, therefore, practically unlimited, but new marshes are constantly forming and result from the drying up of shallow lakes and rivers. These lands are useless for any other purpose, as the drainage and fertilization to supply their natural deficiency would cost so much as to make such reclamation for the higher plants quite out of the question.

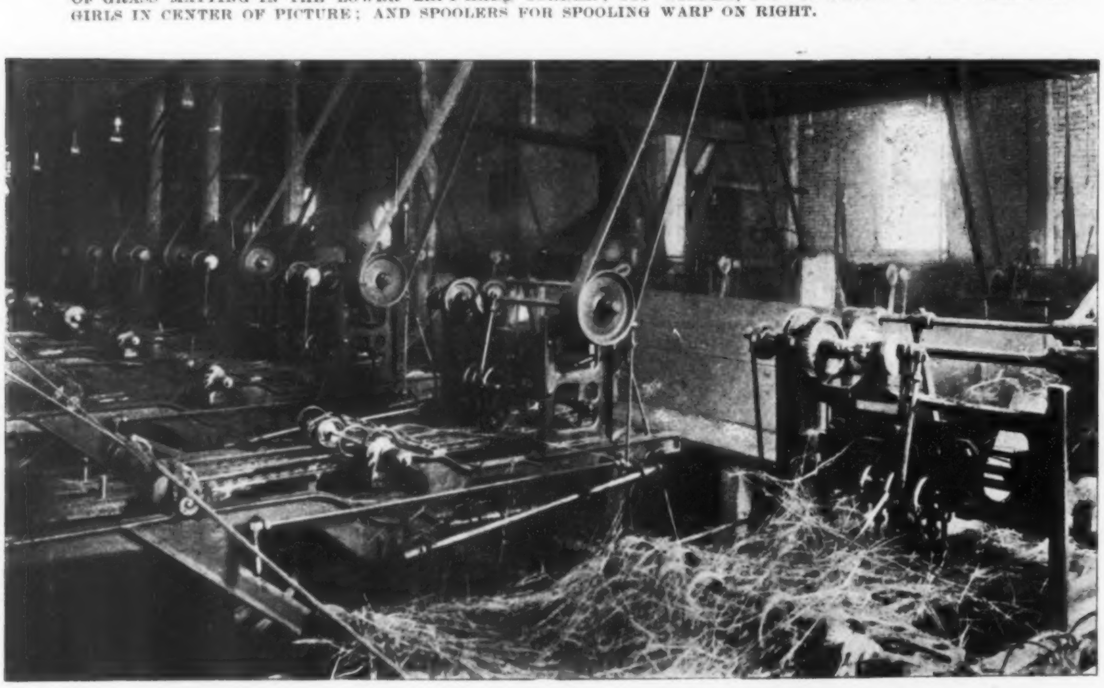
Wire grass is also useless for grazing or feeding purposes, as it is harsh and tough and practically without nutritive substance, and is, in fact, valuable only for fiber, being fit only for purposes that require a peculiarly strong, durable and workable fiber which can be obtained at a minimum of expense and in a maximum quantity. Vast tracts of *Carex stricta* were for years considered as worse than useless. At length it occurred to a few men to see what could be done with binder twine made from wire grass. The inception of the industry was due to the invention of a machine for spinning grass twine which was invented and patented by George A. Lowry. It gave such promise that capital was interested. Improvements in spinning and other machines were made and the manufacture of grass twine began on a commercial scale in November, 1897, at Oshkosh, Wis.

The grass twine proved profitable for binding wheat and other grains at harvest. It was also woven into mattings, which from the beginning gave promise of being a staple product and found ready sale. From this small beginning a vast development rapidly took place. Every detail of the work being absolutely new, original machinery had to be perfected for every process. The demand for wire grass products increased rapidly, until enormous plants were built in the Northwest at Oshkosh and West Superior, Wis., and St. Paul, Minn. A large harvester works for building machinery for harvesting the grass was also acquired and a large factory for the manufacture of furniture was established at Brooklyn, N. Y. All the various interests were merged into the American Grass Twine Company, and large tracts of land were purchased and leased.

One of the greatest difficulties in the early stages of the industry was gathering the grass and its transportation over the marshes. Wagon-roads were constructed, and tracks from the nearest railroad had to be laid to the warehouses in which the grass was stored. The grass is harvested much like wheat. In the earlier harvest a self-raking reaper is used, which lays the grass in gavels, where it cures for about twenty-four hours and is then gathered by special machines which tie the grass into bundles. Later, when the grass is not so succulent, it is cut with an ordinary self-binder and bound into bundles like wheat. The harvest goes on regardless of weather, as wild grass is not frail, nor subject to damage by rain or wet weather, as are grains and other grasses. The grass as cut is always kept straight and untangled, and put into great stacks or sheds protected from rain and snow. Here the grass goes through the sweat or ordinary curing process, when it is baled in large bales, averaging about 200 pounds in weight. These bales are then hauled to large warehouses at convenient shipping points, from which the grass is delivered to the various factories as required. To facilitate the proper harvesting of the grass, fifteen main camps have been established at locations convenient to the great marshes, after the plan adopted in great lumber districts. Each camp accommodates from 60 to 220 men and stables for as many horses. Each camp has a separate cook and is supplied from the general commissary department. Supplies for the men as well as grain and hay for the horses are obtained from the company's own farm land. In all over 2,000 men are employed in the harvest, and the area harvested last year was larger than the acreage harvested by any individual or corporation in America. In single fields could be seen as many as fifty reapers, and an equal number of binders busy at one time.

The baled grass is received at the factory by trainloads and stored in warehouses until it is to be used. The bales, when taken from the warehouses, are loaded upon a chain conveyer and are carried to the third story of the mill and distributed to the combers. The first operation is to separate the short stems and extraneous matter from the long grass, which is done by an ingenious process. As fast as the grass is combed it is tied in bundles weighing about 10 pounds each. The grass in these bundles is clean, straight, and bright green in color, firm and hard like a bundle of small wires and each blade making an indestructible fiber 3 or 4 feet long. The combed grass then passes by a system of conveyers from the combing room to the spinning room. The spinning machines are of such a character that by them the grass fiber is automatically drawn out and laid end to end in "broken joints" in one continuous sliver. By the action of the drawing mechanism, this perfect sliver is drawn through the presses and in doing so is given the proper twist to make a substantial cord or twine. This twine is now roped with a small thread of cotton, hemp or flax to keep the ends from projecting. This makes the finished, smooth and even twine which is the best product of the whole industry. The twine then passes through the drawhead and is wound upon a spool. When the spool is full it makes a package about 16 inches in diameter and 20 inches long and weighs about 50 pounds. This bundle of twine is tied at four points through the center and removed from the spool and is now ready for use in other divisions

WEAVING ROOM, SHOWING LOOMS WITH OPERATIVES ON LEFT-HAND SIDE, AND A PARTIALLY COMPLETED ROLL OF GRASS MATTING IN THE LOWER LEFT-HAND CORNER; COP WINDER, JUST IN FRONT OF THE GROUP OF GIRLS IN CENTER OF PICTURE; AND SPOOLERS FOR SPOOLING WARP ON RIGHT.



BOTTLE COVER DEPARTMENT, SHOWING BOTTLE COVER MACHINES IN OPERATION.

MANUFACTURING WIRE GRASS MATTINGS AND BOTTLE COVERS.

of the industry. If intended for binding twine it is rewound into self-contained and self-sustaining packages weighing about 22 pounds each. A small percentage of short material which is combed out from the grass is taken to the bottle-covering department. There it is fed into a machine which spreads the grass out into a flat layer and sews two seams through the same, clips the end to the proper width for wrapping a bottle and attaches a cord for wrapping around the cover when it is put about a bottle to secure it in place. The completed bottle-covers are dropped automatically from the machine, gathered up and packed into bales, each containing about 500. The twine may be twisted into rope or made into a braid containing from three to five strands.

This rope is used for tying up the various products and in the manufacture of various parts of furniture and for many commercial uses to which cheap cordage is applied. If the twine is to be woven into mats or fabrics, it is wrapped with various colors of cotton yarns to produce the desired color effects in the various patterns of woven goods. The looms used are especially designed and perfected for this work and are different in some respects from any other loom. They are adapted for weaving goods in widths varying from 36 to 108 inches. The latter loom is used for making goods 8 or 9 feet wide, to be sold as art squares. Looms for weaving goods 12 feet wide are now being made. The matting is woven into lengths of 50 yards, and after being marked with the date, number of loom, number of employé and pattern of goods, they are taken to the inspection department, where each piece of goods is unrolled upon a long table and both sides carefully inspected and all broken warps and other imperfections are corrected.

After the perfect goods have passed inspection, they are passed through a heavy calender which smooths the fabric, makes it compact and firm and leaves it in such condition that it is ready for the shearing process. This shearing process is accomplished by passing the goods through a napping machine. It contains several sets of steel brushes, which being revolved very rapidly and pressed lightly against the surface of the goods, have a tendency to loosen the stubs and fibers from the surface of the fabric and cause them to project in such a manner that as the fabric passes beneath the revolving knives, these fibers and roughnesses are clipped off. This leaves the surface of the goods smooth and clean from projecting stems or cracks, and very materially improves the appearance and quality of the goods. After passing twice through this machine, so that both sides receive the same thorough treatment, the goods are formed into compact rolls about 20 inches in diameter and weighing 120 pounds.

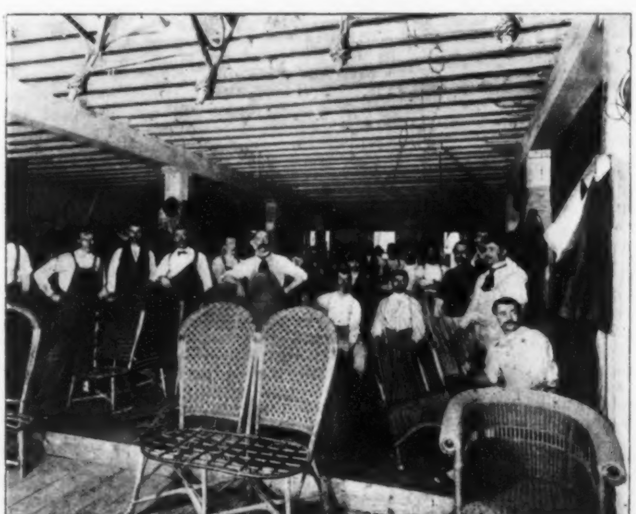
Matting to be used for making rugs receives exactly the same treatment, but after being finished is transferred to the trimming department for further operations. It is first passed into a double sewing machine, which sews and trims both margins, and then passes through a second machine which binds both edges at the same time. This long piece of matting bound on both edges is then cut into proper lengths for the various sizes of rugs by means of a special machine which sews both ends and cuts them at the same time. These mats are then fringed on both ends.

From what has been said it will be seen that with *Carex stricta* there is no rotting of the fiber, no decortication and no chemicals or other treatment required to remove the woody portions from the fiber. All the processes which wire grass undergoes from the time of its cutting to the completion of the goods, are purely mechanical. Each blade of grass is in itself one complete and perfect fiber, quite indestructible and requiring no treatment to make it workable. The grass is not subjected to any process which in any way weakens the natural strength and pliability of the fiber. Because of the absence of such a process, the twine and finished goods made therefrom always retain the beautiful surface and delightful color of the perfect grass. Wire grass fabrics are woven, not only into floor mattings and rugs, but carpet linings, floor deadenings, coverings, finishings for ceilings, etc. Such fabrics are made in great variety of shapes, forms, colors and designs. At the large factory of the American Furniture and Manufacturing Company, in Brooklyn, wire grass twine is utilized to manufacture chairs, settees, tables, screens, doors, baby carriages, music stands, flower stands, hampers, and baskets of all kinds, and many other novelties. One of our engravings shows an entire room fitted up with wire grass furnishings, including floor coverings, chairs, tables and even picture frames. So from the wild prairies American wire grass reaches our homes.

PARLOR ENTIRELY FURNISHED AND DECORATED FROM PRODUCTS OF WIRE GRASS.

Nickel steel possesses some peculiar quality which renders cutting tools useless in a short time. Taps and dies, it is stated, are worn out most rapidly by it.

WIRE GRASS AFTER CUTTING.



FURNITURE DEPARTMENT.

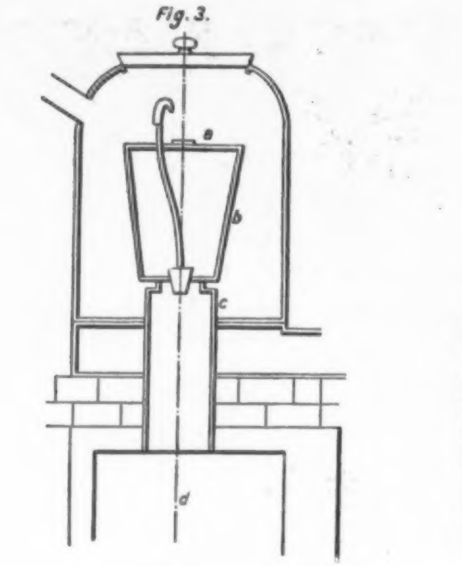
BASKET DEPARTMENT.

ENAMELING.—IV.

STOVES AND FURNACES.

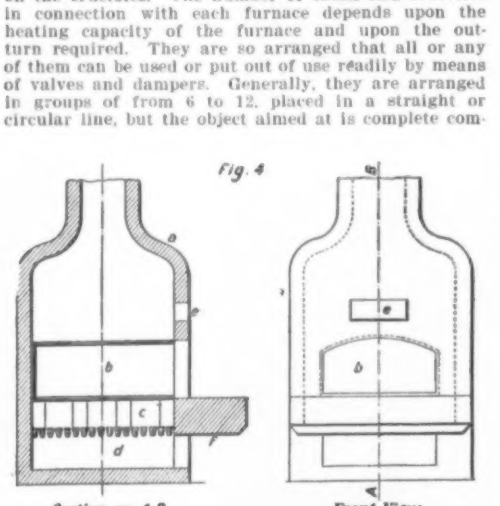
FRITTING and Fusing.—The best results are obtained in enameling when the thoroughly ground and mixed constituents are fused together, reground, and then applied to the metal surface. In cheap enamels the gray is sometimes applied without being previously melted, but it lacks the durability which is obtained

Fig. 3.



by thorough fusion and regrinding. In smelting enamel one of two kinds of furnaces may be used, viz., tank or crucible. The former is better adapted to the melting of considerable quantities of ordinary enamel, while the latter is more suitable for smaller quantities or for finer enamels, as the mixture is protected from the direct action of the flames by covers on the crucibles. The number of tanks and crucibles in connection with each furnace depends upon the heating capacity of the furnace and upon the outturn required. They are so arranged that all or any of them can be used or put out of use readily by means of valves and dampers. Generally, they are arranged in groups of from 6 to 12, placed in a straight or circular line, but the object aimed at is complete combustion of the fuel, and the utilization of the heat to the fullest extent. One arrangement is to have the flame pass along the bottom and sides of the tank and then over the top to the chimney.

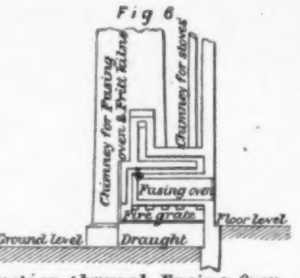
Fig. 4



Section on A.B. Front View

The general system in use is, however, the crucible system. The crucibles are made from the best fireclay, and the most satisfactory are sold under the name of "Hessian crucibles." The chief objection to the use of the crucibles is that of cost. They are expensive, and in many factories the life of the crucible is very short, in some cases not extending beyond one period of fusion. When this, however, is the rule rather than the exception, the results are due to carelessness. Sudden heating or cooling of the crucible will cause it to crack or fall to pieces, but for this there is no excuse. Running the molten material quickly out of the crucible and replacing it hurriedly with a fresh cold mixing is liable—in fact, almost certain—to produce fracture, not only causing the destruction of the crucible, but also the loss of the mixing. New crucibles should be thoroughly dried in a gentle heat for some days and then gradually raised to the requisite temperature which they must sustain for the purposes of fusion. Sometimes unglazed porcelain crucibles specially prepared with a large proportion of china-clay are used. These are, however, expensive and require special attention during the first melt. The life of all crucibles can be lengthened by: (1) Gradually heating them before putting them into the fire; (2) never replacing a frit with a cold mass for the succeeding one; it should first be heated in a stove and then introduced into the crucible; (3) carefully protecting the hot crucibles from cold draughts or rapid cooling.

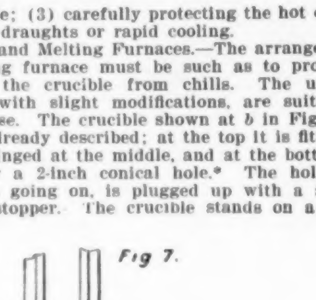
Fig 6



Section through Fusing Oven.

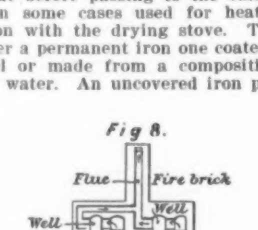
Melting and Melting Furnaces.—The arrangement of the melting furnace must be such as to protect the whole of the crucible from chills. The usual pit furnaces, with slight modifications, are suitable for this purpose. The crucible shown at *b* in Fig. 3 is of the type already described; at the top it is fitted with a lid, *a*, hinged at the middle, and at the bottom it is pierced by a 2-inch conical hole.* The hole, while melting is going on, is plugged up with a specially prepared stopper. The crucible stands on a tubular fireproof support, *c*, which allows the molten mass to be easily run off into a tub of water, which is placed in the chamber, *d*. The fuel is thrown in from the top, and the supply must be kept uniform. From four to six of these furnaces are connected to the same chimney; but before passing to the chimney the hot gases are in some cases used for heating purposes in connection with the drying stove. The plug used may be either a permanent iron one coated with a very hard enamel or made from a composition of quartz powder and water. An uncovered iron plug would be unsuitable owing to the action of the iron on the ingredients of the mixing.

Fig 7.



Section on A.B.

Fig 8.

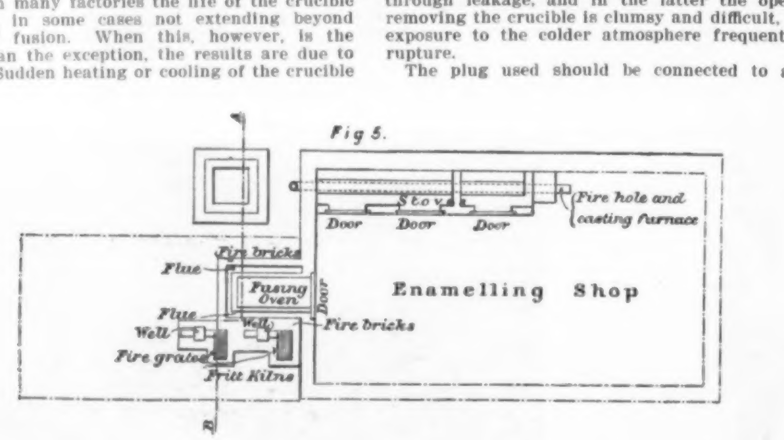


Section thro. Fritt Kilns.

In some cases only a very small hole is made in the crucible and no stopper used, the fusion of the mixing automatically closing up the hole. In some other factories no hole is made in the crucible, and when fusion is complete the crucible is removed and the mixing poured out. The two latter systems are bad; in the first there is always some waste of material through leakage, and in the latter the operation of removing the crucible is clumsy and difficult, while the exposure to the colder atmosphere frequently causes rupture.

The plug used should be connected to a rod, as shown at Fig. 3, which passes through a slot in one half of the hinged lid, *a*. When fusion is complete this half is turned over, and the plug pulled up, thus allowing the molten mass to fall through into the vat of water placed underneath. The mixing in the crucibles, as it becomes molten, settles down, and more material can then be added until the crucible is nearly full. If the mixing is correctly composed, and has been thoroughly fused, it should flow freely from the crucible when the plug is withdrawn. Fusing generally requires only to be done once, but for fine enamels the operation may be repeated. The running off into the water is necessary in order to make the mass brittle and easy to grind. If this was not done it would again form into hard flinty lumps and require much time and labor to reduce to a powder.

Fig 5.



* Two inches for gray, one inch for glaze; the hole should be wider at the top.

A careful record should be kept of the loss in weight of the dried material at each operation. The weighings should be made at the following points: (1) Before and after melting; (2) after crushing.

The time required for melting varies greatly, but from six to nine hours may be considered as the extreme limits. Gas is now coming into considerable use for raising the necessary heat for melting. The generator may be placed in any convenient position, but a very good system is to have it in the center of a battery of muffles, any or all of which can be brought into use. When quartz stoppers are used there is considerable trouble in their preparation, and as each new batch of material requires a fresh stopper, wrought iron stoppers have been introduced in many factories. These are coated with an enamel requiring a much higher temperature of fusion than the fundamental substance, and this coating prevents the iron having any injurious action on the frit.

Fusing.—For fusing the enamel muffle furnaces are used; these furnaces are simple in construction, being designed specially for: (1) Minimum consumption of fuel; (2) maximum heat in the muffle; (3) protection of the inside of the muffle from dust, draughts, etc.

The muffle furnaces may be of any size, but in order to economize fuel, it is obvious that they should be no larger than is necessary for the class and quantity of work being turned out. For sign-plate enameling the interior of the muffle may be as much as 10 feet by 5 feet wide by 3 feet in height, but a furnace of this kind would be absolutely ruinous for a concern where only about a dozen small hollow-ware articles were enameled at a time. The best system is to have two or three muffle furnaces of different dimensions, as in this way all or any one of them can be brought into use as the character and number of the articles may require. The temperature throughout the muffle is not uniform, the end next to the furnace being hotter than that next to the door. In plate enameling it is therefore necessary that the plates should be turned so that uniform fusion of the enamel may take place. In the working of hollow-ware the articles should be first placed at the front of the muffle and then moved toward the back. The front of the furnace is closed in by a vertically sliding door or lid, and in this an aperture is cut, through which the process of fusion can be inspected. All openings to the muffle should be used as little as possible; otherwise cold air is admitted, and the inside temperature rapidly lowered.

Fig. 4 shows a simple arrangement of a muffle furnace; *a* is the furnace itself, with an opening, *e*, through which the fuel is fed; *b* is the muffle, *c* shows the firebars, and *d* the cinder box, *f* is a rest or plate on which is placed the articles to be enameled. The plate or petits on which the articles rest while being put into the muffle should be almost red hot, as the whole heat of the muffle in this way begins to act immediately on the enamel coating. The articles inside the muffles can be moved about when necessary, either by a hook or a pair of tongs, but care must be taken that every part of the vessel or plate is submitted to the same amount of heat.

In Figs. 5, 6, and 7 are given drawings of an arrangement of furnaces, etc., connected with an enameling factory at present working. The stoves shown in Fig. 5 are drying stoves fired from the end by charcoal, and having a temperature of about 160 deg. F. Fig. 6 shows the arrangement of the flues for the passage of the gases round the fusing oven. The section through the line *A B*, Fig. 5, as shown in Fig. 7, and the section through the frit kilns, as shown in Fig. 8, are sufficiently explanatory. The frit kilns and the fusing oven flues both lead to the brick chimney, but the stoves are connected to a wrought iron chimney shown in Fig. 6. Another arrangement would have been to so arrange the stoves that the gases from the frit kilns could have been utilized for heating purposes.

COMPARISON OF THE MERCHANT FLEETS OF THE WORLD.

THE progress made by some of our industrial competitors in shipbuilding and shipowning is very considerable, and its influence in the diversion of commerce is still more marked than statistics suggest. So long as the shipper has sufficient cargo for one, or even several ports consecutive upon an ocean route, to fill a ship of moderate size, it may be just as convenient to charter a "tramp" steamer belonging to any nation, always provided that the freight is low enough, and the British "tramps" are excellent in this respect. But with the beginnings of foreign commerce, the general experience is that the consignments are comparatively small, and that much canvassing over a wide area is necessary to secure a complete cargo even for a series of ports. In such a case it is of great importance to have trading steamers as distinct from the "tramp," and that these steamers shall leave the manufacturing country at regular intervals, so as to distribute goods at stated periods. It will be recognized that, hitherto at all events, Britain has held an advanced lead, and that foreign nations have commonly had to send their foreign goods via London or Liverpool, to the disadvantage of the growth of their trade. The transhipment necessary in such case is not only costly, but results in breakage, as well as inconvenience. Germany fully recognized this a few years ago, and the results have been very striking. At the present time she has as many sailings across the Atlantic as Britain. She has a splendid fortnightly service to the Far East, her ships call at convenient ports, whence coasting vessels, as well as river steamers, distribute the German manufactures locally; indeed, the principal communication with Siam, and prac-

tically the whole local trade, is now in the hands of the Germans. India, China, Japan, and Australia have arrivals from Germany every fortnight. There is a large subsidy for maintaining these services, which are conducted by the Hamburg-American and North German Lloyd companies, working conjointly. Recently a new contract was entered into for a service which will embrace not only the East Coast of Africa, as hitherto, but also the West Coast; and larger and faster steamers are being built for the purpose, under a subsidy which will insure a return upon the capital involved. The East African steamers have been running monthly for some years, and it is an evidence of the advantage of such regular communication that the value of goods carried has increased in seven years from £610,000 to £1,956,950 sterling, of which £300,000 and £955,000 respectively were German manufactures. There is also a regular service to the West Indies and South America, and it will be seen that although the German merchant navy is now only one-fifth in point of tonnage that of the British merchant navy, its effect on the distribution of consignments of German goods is greater than mere comparisons of tonnage suggest.

The French fleet has not been materially increased, notwithstanding heavy subsidies, although the Messageries Maritimes and the French Transatlantic Company have done great service in the promotion of French foreign trade; both have their own shipbuilding yards—inadequate as regards the former company —and beyond these establishments little is done in merchant shipbuilding, a result in large measure due to the high protective tariffs, which are not fully compensated for by the shipping and shipbuilding subsidies.

In the United States, on the other hand, there seems every prospect of a new subsidy scheme being brought forward, as it is recognized that much good might accrue from regular sailings to foreign ports. The only distinctly American lines are those to Southampton, and another across the Pacific; and Americans reproach themselves with the surprising fact that only 13 per cent of the foreign import trade, and 7 per cent of the foreign export trade, is carried in American vessels; whereas in the days of the old wooden sailing-ships, 25 per cent to 30 per cent was the average; the decrease has been very gradual. The increase in American merchant shipping in recent years has been largely on the Lakes and in the coasting trade of the United States. But a new period is at hand, when the United States will endeavor to gain the same position with a modern merchant fleet that she once enjoyed with her famous wooden sailing-ships.

The accompanying diagrams illustrate by a series of flags the growth of the principal merchant fleets of the world during the past ten years. In this diagram it is assumed that three sailing-ship tons are only equal to one steam ton; thus the diagram is on the basis of steam tonnage, and is consequently a more accurate measure of the carrying capacity of the respective fleets than if sailing and steam tonnage had been reckoned of equal importance. Reckoned on this basis, the British tonnage has increased from 8,584,600 to 11,700,000; the German tonnage has increased from 1,146,000 to 2,116,000; and the United States tonnage from 952,900 to 1,131,151; the only other increases worth noting are those of Norway, from 693,000 to 1,056,600; of Russia, from 246,500 to 476,900; and of Sweden, from 279,900 to 456,000. Generally speaking, each nation has considerably increased its carrying capacity, although in varying

TABLE I.—RECKONING SAIL AND STEAM TONNAGE AS EQUAL, THE TONNAGE IN 1890 AND 1900 WAS AS FOLLOWS:

	1890.		1900.	
	No.	Tons.	No.	Tons.
United Kingdom	9167	10,241,856	8914	13,241,446
British Colonies	2904	1,355,250	1924	1,019,808
America, United States of	3272	1,823,882	2820	2,035,062
Austria-Hungary	368	269,648	270	416,084
Danish	808	280,065	802	·519,011
Dutch	544	378,784	406	530,277
French	1380	1,045,102	1214	1,350,562
German	1876	1,569,311	1710	2,650,033
Italian	1555	816,567	1176	983,655
Norwegian	3909	1,584,355	2980	1,640,812
Russian	1181	427,335	1246	720,901
Spanish	883	534,811	597	694,780
Swedish	1470	475,964	1433	637,272

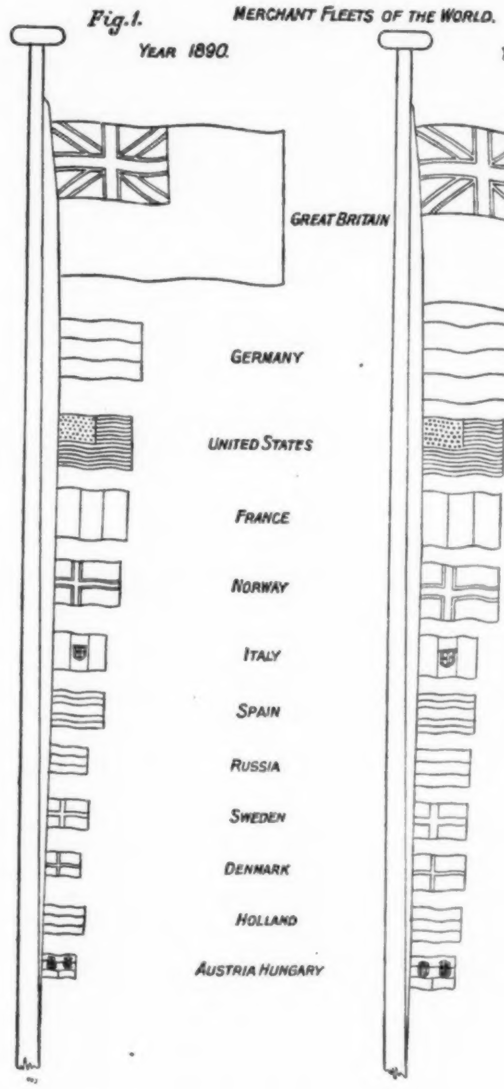
proportions. The vast value of the shipping trade of the world may be indicated by an approximate estimate. In a computation of the exports of all the principal countries in the world it is found that the value of all the exports from the contributing countries in 1886 increased in value by over £200,000,000 sterling by the time they became imports at their destination; and while some part of this increase may be due to profits, insurance, etc., a large proportion is to be accounted for by transport charges. In 1898 the corresponding advance—a rough measure of the value of the world's transport trade—was £228,000,000 sterling. The increase here is at a much less percentage than the addition to the volume of trading, indicating much cheaper transport. It becomes of interest to ascertain whether or not Britain's share of this great transport trade is a relatively increasing or a decreasing quantity. The only method of arriving at such a result is to take as a basis the tonnage of merchant ships entering into, and clearing from, the harbors of different countries. This is shown by two contrast diagrams in which the totals are given on a line divided to indicate the total tonnage, the tonnage owned by the country itself, and the tonnage of foreign ships other than British. The years compared are 1880 and 1889. In the case of the United States, the British proportion has in twenty years increased from 51 per cent to 57 per cent of the total, the British tonnage frequenting American ports having gone up from 15,000,000 to 25,000,000. The German tonnage has increased from 2,250,000 to 4,614,000 tons; but with the exception of Norway and Sweden, the other increases are barely proportionate to the total. As regards the shipping in French ports, our proportion in twenty years has increased from 40 to 47 per cent, while the home tonnage has decreased by several points. In the case of Germany we find that a very considerable increase has been made in the total, and that the home tonnage has more than kept pace with this increase, the proportion having gone up from 39 to over 44 per cent, while Britain's proportion has considerably decreased —from 37 to 32 per cent. As regards Russia, it will be seen that our position has improved, but that Italy has captured the larger proportion of the augmented tonnage frequenting her own ports, the ratio of Italian tonnage having increased from 34 to 44 per cent, while ours has decreased to 26 per cent. In the Belgian tonnage the foreigner has made greater progress than ourselves, due largely to German ships, while in Sweden and Norway we fail to hold our position; in respect to Holland our position has barely kept pace with the total tonnage.

As to Britain, it may be said that the foreign tonnage frequenting her harbors has in twenty years increased from 17 1-3 to 35 million tons; if we eliminate ships in ballast and take only sailing and steam vessels with cargoes, the increase is practically in the same proportion, 13¾ to 27½ million tons. Of the total increase in fifteen years, of 25,000,000 tons of shipping entering or leaving the United Kingdom with cargo only, 13,000,000 is due to the foreigner and barely 12,000,000 to the British ships. Of all shipping in our harbors in 1880, 29.6 per cent carried foreign flags while now the proportion is 34 per cent.

On the other hand, wages are higher, and since labor-saving machinery can enter into the cost of building ships only to a more or less restricted extent, the labor cost of a ship is greater, probably from 10 per cent to 15 per cent. Material, on the other hand, is cheaper in America; and wherever it is possible machinery has been adopted to a greater extent than in this country. In spite of high labor, new shipbuilding yards are being installed in the United States for the execution of government, as well as of private, contracts.

It is difficult to obtain accurate comparative data on the relative cost of ships, because of the great variations in design, and the fact that the ocean steamer of British build differs much from the coasting or lake steamer as constructed in America. Lake steamers are efficient cargo carriers. The largest of these carry 7,900 tons, and, fitted with quadruple-expansion engines supplied with steam from water-tube boilers, costs at present from £9 to £10 per ton of deadweight, while 3,000-ton steamers cost from £11 to £11 10s. per ton. In this country the ocean "tramp," to take 4,000 tons at 9 knots, costs £10; the 6,000-ton 10-knot steamer, £9 10s., and the 10,000-ton 11-knot steamer, £12 per ton deadweight carrying capacity; so that, even allowing for the lighter scantlings, the American lake ship is not much costlier than the British steamer. In the Lake districts, where there are special facilities in the way of steel and coal, the

Fig. 1. MERCHANT FLEETS OF THE WORLD. Fig. 2.



Coincident with development of home tonnage for home requirements, there has been a steady aim in competing countries to develop the shipbuilding industry. The tendency during the past decade to increase naval armaments has enormously assisted this, for patriotic reasons have suggested the building of those warships at home; at the same time the great shipowning companies were encouraged—a stronger word might even be used—to have their vessels built at home. Existing shipbuilding yards have thus been largely developed to undertake a class of work which fifteen years ago was unknown to them. Formerly all large passenger steamers for Germany, Austria, America, and other countries were built in Great Britain, and it was the rule that complete drawings had to be supplied with each ship. It might be easy from this source to trace the evolution of the large ships built by some of our industrial competitors, but, at the same time, it must be frankly admitted that there have been, particularly in recent years, departures which suggest distinct originality. At the present time our greatest competitor in shipbuilding is Germany; this is due in some measure to the combination of cheap labor with efficient machine tools; in fact, some of the works of Germany are at least as well equipped as those on the Clyde. Without entering into details, it may be said that wages are lower. The engineers, for instance, working on the construction of the great Atlantic liners are paid about half the hourly rate obtaining in some establishments in this country; and although the economy or efficiency of the labor may be less, the total labor cost of work is under that ruling in this country. In America,

only chance of competition at present with British builders appears to be in the event of a trade being developed between the Lakes and the Atlantic; a practice already inaugurated. The canal lock which limits the dimensions for vessels to trade between the inland Lake ports and the Atlantic is 270 feet long, 45 feet wide, and 14 feet deep.

In the prices given above there has been an advance of 50 per cent, so far as Britain is concerned, as compared with those of a few years ago, largely owing to the cost of labor, not only in the shipbuilding yard, but at the steel works; it is doubtful if in the immediate future labor rates will recede to their former level. It is interesting to note the relation of the cost of labor to the total cost in regard to British ships. Table II. indicates such costs now and ten years ago for different classes of ships constructed at works which are among the best in this country, so far as machinery and management are concerned. It should be noted that wages have considerably increased during the ten years referred to, so that in the comparison some allowance must be made for this, where the intention is to ascertain the effect of improved mechanical appliances toward the greater economy of labor. In the case of the hull there seems practically no change, the slight increase shown in several cases being probably due to the higher rate of wage. Generally there has been a slight decrease in the labor cost of the engines, which is, perhaps, the result of the introduction of automatic machine tools and increased cutting speeds in lathes and the like. But in the case of boilers there is no marked improvement. Modern high pressures demand more

careful workmanship, so that the labor bill is necessarily higher.

Commendation may here be expressed for a practice now being introduced in one or two of the American works, where a mathematician is specially engaged to work out formulæ for establishing the length of time necessary for any job in the machine shop; the needed speed, cut, and traverse being thus ascertained, the machine-man when he gets the job has these data given to him, and is thereby informed of the time a job should take, and how it may be accomplished within that time. The result is said to be a marked economy.

The limited application of machinery possible in the building of the ship has till now militated against the extension of the American merchant marine; but should Congress pass a subsidy bill it will compensate the shipowner for the higher capital charge involved in building in the States owing to dearer labor, and there will then be every prospect of a great extension in American merchant shipbuilding in the immediate future. At present there are about ten yards on the United States seaboard capable of producing the largest vessels, besides a number of firms who have facilities for moderate-sized steamers, so that the economic condition is the only obstacle to pronounced success. This is being improved by the extensive additions to the American navy now decided on and under consideration.

TABLE II.—SHOWING LABOR COST IN SHIP CONSTRUCTION.

	Date.	Cost of Labor in Relation of Total Cost.		
		Hull.	Engines.	Boilers.
		Per cent.	Per cent.	Per cent.
Channel passenger steamer....	1890	41.7	28.4	38.6
" " "	1900	41.6	28.8	30.7
Cruiser......	1897	42.3	29.4	38.8
"	1899	46.6	20.4	35.2
Battleship.................	1891	46.8	21.8	40.0
"	1897	49.6	24.7	41.5
Cargo steamer...............	1899	38.2	28.8	35.0
" "	1900	40.1	22.7	39.9
Paddle steamer.............	1891	40.9	32.5	37.8
" "	1898	42.0	30.5	38.8

In Germany there has been a steady advance in the number of shipbuilding works, as the following table indicates:

TABLE SHOWING GROWTH OF SHIPBUILDING IN GERMANY.

Year.	Number of Works.	Number of Workers.	Shipbuilding Slips.	Docks.
1870	7	2,800	16	2
1880	18	8,500	47	9
1890	25	21,800	103	17
1900	39	37,750	154	27

Simultaneously with this increase in the number of such works there has been a material growth in auxiliary industries, particularly in the production of steel plates for shipbuilding, which are now exported to the Clyde and elsewhere. Again, although raw material is admitted to Germany free of duty, the quantity imported in 1899 was only 39,000 tons, as compared with 52,000 tons in the preceding year; at the same time the total tonnage of steel actually used had increased from 69,000 to 85,000 tons.—Engineering.

EDUCATION.*

THE invitation of the British Association to preside over the Section of Education, established this year for the first time, has been given to me as a representative of the Government Department which controls the larger, but perhaps not the most efficient, part of the education of the United Kingdom. The most suitable subject for my opening address would therefore seem to me the proper function of national authority, whether central or local, in the education of the people; what is the limit of its obligations; what is the part of education in which it can lead the way; what is the region in which more powerful influences are at work, and in which it must take care not to hinder their operation; and what are the dangers to real education inseparable from a general national system. I shall avoid questions of the division of functions between central and local authorities, beset with so many bitter controversies, which are political rather than educational.

In the first place, so far as the mass of the youth of a country is concerned, the public instructor can only play a secondary part in the most important part of the education of the young—the development of character. The character of a people is by far its most important attribute. It has a great deal more moment in the affairs of the world, and is a much more vital factor in the promotion of national power and influence, and in the spread of empire, than either physical or mental endowments. The character of each generation depends in the main upon the character of the generation which precedes it; of other causes in operation the effect is comparatively small. A generation may be a little better or a little worse than its forefathers, but it cannot materially differ from them. Improvement and degeneracy are alike slow. The chief causes which produce formation of character are met with in the homes of the people. They are of great variety and mostly too subtle to be controlled. Religious belief, ideas, ineradicable often in maturer life, imbibed from the early instruction of parents, the principles of morality current among brothers and sisters and playmates, popular superstitions, national and local prejudices, have a far deeper and more permanent effect upon character than the instruction given in schools or colleges. The teacher, it is true, exercises his influence among the rest. Men and women of all sorts, from university professors to village dames, have stamped some part of their own character upon a large proportion of their disciples. But this is a power that must grow feebler as the number of scholars is increased. In the enormous schools and classes in which the public instruction of the greater part of the children of the people is given the influence on character of the individual teacher is reduced to a minimum. The old village dame might teach her half-dozen children to be kind and brave and to speak the truth, even if she failed to teach them to read and write. The head master of a school of two thousand, or the teacher of a class of eighty, may be an incomparably better intellectual instructor, but it is impossible for him to exercise much individual influence over the great mass of his scholars.

There are, however, certain children for the formation of whose characters the nation is directly responsible—deserted children, destitute orphans, and children whose parents are criminal or paupers. It is the duty and interest of the nation to provide for the moral education of such children and to supply artificially the influences of individual care and love. The neglect of this obligation is as injurious to the public as to the children. Homes and schools are cheaper than prisons and workhouses. Such a practice as that of permitting dissolute pauper parents to remove their children from public control to spend the summer in vice and beggary at races and fairs, to be returned in the autumn, corrupt in body and mind, to spread disease and vice among other children of the State, would not be tolerated in a community intelligently alive to its own interest.

A profound, though indirect and untraceable, influence upon the moral education of a people is exercised by all national administration and legislation. Everything which tends to make the existing generation wiser, happier, or better, has an indirect influence on the children. Better dwellings, unadulterated food, recreation grounds, temperance, sanitation, will all affect the character of the rising generation. Regulations for public instruction also influence character. A military spirit may be evoked by the kind of physical instruction given. Brutality may be developed by the sort of punishments enjoined or permitted. But all such causes have a comparatively slight effect upon national character, which is in the main the product for good or evil of more powerful causes which operate, not in the school, but in the home.

For the physical and mental development of children it is now admitted to be the interest and duty of a nation in its collective capacity to see that proper schools are provided in which a certain minimum of primary instruction should be free and compulsory for all, and, further, secondary instruction should be available for those fitted to profit by it. But there are differences of opinion as to the age at which primary instruction should begin and end; as to the subjects it should embrace; as to the qualifications which should entitle to further secondary instruction; and as to how far this should be free or how far paid for by the scholar or his parents.

The age at which school attendance should begin and end is in most countries determined by economic, rather than educational, considerations. Somebody must take charge of infants in order that mothers may be at leisure to work; the demand for child labor empties schools for older children. In the United Kingdom minding babies of three years old and upward has become a national function. But the infant "school," as it is called, should be conducted as a nursery, not as a place of learning. The chief employment of the children should be play. No strain should be put on either muscle or brain. They should be treated with patient kindness, not beaten with canes. It is in the school for older children, to which admission should not be until seven years of age, that the work of serious instruction should begin, and that at first for not more than two or three hours a day. There is no worse mistake than to attempt by too early pressure to cure the evil of too early emancipation from school. Beyond the mechanical accomplishments of reading, writing, and ciphering, essential to any intellectual progress in after life, and dry facts of history and grammar, by which alone they are too often supplemented, it is for the interest of the community that other subjects should be taught. Some effort should be made to develop such faculties of mind and body as are latent in the scholars. The same system is not applicable to all; the school teaching should fit in with the life and surroundings of the child. Variety, not uniformity, should be the rule. Unfortunately, the various methods by which children's minds and bodies can be encouraged to grow and expand are still imperfectly understood by many of those who direct or impart public instruction. Examinations are still often regarded as the best instrument for promoting mental progress; and a large proportion of the children in schools, both elementary and secondary, are not really educated at all—they are only prepared for examinations. The delicately expanding intellect is crammed with ill-understood and ill-digested facts, because it is the best way of preparing the scholar to undergo an examination test. Learning to be used for gaining marks is stored in the mind by a mechanical effort of memory, and is forgotten as soon as the class-list is published. Intellectual faculties of much greater importance than knowledge, however extensive—as useful to the child whose schooling will cease at fourteen as to the child for whom elementary instruction is but the first step in the ladder of learning—are almost wholly neglected.

The power of research—the art of acquiring information for one's self—on which the most advanced science depends, may be a proper system to be cultivated in the youngest scholar of the most elementary school. Curiosity and the desire to find out the reason of things is a natural, and to the ignorant an inconvenient, propensity of almost every child; and there lies before the instructor the whole realm of Nature knowledge in which this propensity can be cultivated. If children in village schools spent less of their early youth in learning mechanically to read, write, and cipher, and more in searching hedgerows and ditch-bottoms for flowers, insects, or other natural objects, their intelligence would be developed by active research, and they would better learn to read, write, and cipher in the end. The faculty of finding out things for one's self is one of the most valuable with which a child can be endowed. There is hardly a calling or business in life in which it is not better to know how to search out information than to possess it already stored. Everything, moreover, which is discovered sticks in the memory and becomes a more secure possession for life than facts lazily imbibed from books and lectures. The faculty of turning to practical uses knowledge possessed might be more cultivated in primary schools. It can to a limited extent, but to a limited extent only, be tested by examination. Essays, compositions, problems in mathematics and science, call forth the power of using acquired knowledge. Mere acquisition of knowledge does not necessarily confer the power to make use of it. In actual life a very scanty store of knowledge, coupled with the capacity to apply it adroitly, is of more value than boundless information which the possessor cannot turn to practical use. Some measures should be taken to cultivate taste in primary schools. Children are keen admirers. They can be early taught to look for and appreciate what is beautiful in drawing and painting, in poetry and music, in nature, and in life and character. The effect of such learning on manners has been observed from remote antiquity.

Physical exercises are a proper subject for primary schools, especially in the artificial life led by children in great cities; both those which develop chests and limbs, atrophied by impure air and the want of healthy games, and those which discipline the hand and the eye—the latter to perceive and appreciate more of what is seen, the former to obey more readily and exactly the impulses of the will. Advantage should be taken of a quasi-public officer—the school teacher—to secure them protection, to which they are already entitled by law, against hunger, nakedness, dirt, overwork, and other kinds of cruelty and neglect. Children's ailments and diseases should by periodic inspection be detected; the milder ones, such as sores and chilblains, treated on the spot, the more serious removed to the care of parents or hospitals. Diseases of the eye and all maladies that would impair the capacity of a child to earn its living should in the interest of the community receive prompt attention and the most skillful treatment available. Special schools for children who are crippled, blind, deaf, feeble-minded, or otherwise afflicted should be provided at the public cost, from motives, not of mere philanthropy, but of enlightened self-interest. So far as they improve the capacity of such children they lighten the burden on the community.

I make no apology for having dwelt thus long upon the necessity of a sound system of primary instruction; that is the only foundation upon which a national system of advanced education can be built. Without it our efforts and our money will be thrown away. But while primary instruction should be provided for, and even enforced upon all, advanced instruction is for the few. It is the interest of the commonwealth at large that every boy and girl showing capacities above the average should be caught and given the best opportunities for developing those capacities. It is not its interest to scatter broadcast a huge system of higher instruction for anyone who chooses to take advantage of it, however unfit to receive it. Such a course is a waste of public resources. The broadcast education is necessarily of an inferior character, as the expenditure which public opinion will at present sanction is only sufficient to provide education of a really high caliber for those whose ultimate attainments will repay the nation for its outlay on their instruction. It is essential that these few should not belong to one class or caste, but should be selected from the mass of the people, and be really the intellectual *élite* of the rising generation. It must, however, be confessed that the arrangements for selecting these choice scholars to whom it is remunerative for the community to give advanced instruction are most imperfect. No "capacity-catching machine" has been invented which does not perform its function most imperfectly: it lets go some it ought to keep, and it keeps some it ought to let go. Competitive examination, besides spoiling more or less the education of all the competitors, fails to pick out those capable of the greatest development. It is the smartest, who are also sometimes the shallowest, who succeed. "Whoever thinks in an examination," an eminent Cambridge tutor used to say, "is lost." Nor is position in class obtained by early progress in learning an infallible guide. The dunce of the school sometimes becomes the profound thinker of later life. Some of the most brilliant geniuses in art and science have only developed in manhood. They would never in their boyhood have gained a county scholarship in a competitive examination.

In primary schools, while minor varieties are admissible, those, for instance, between town and country, the public instruction provided is mainly of one type; but any useful scheme of higher education must embrace a great variety of methods and courses of instruction. There are roughly at the outset two main divisions of higher education—the one directed to the pursuit of knowledge for its own sake, of which the practical result cannot yet be foreseen, whereby the "scholar" and the votary of pure science is evolved; the other directed to the acquisition and application of special knowledge by which the craftsman, the designer, and the teacher are produced. The former of these is called secondary, the latter technical, education. Both have numerous subdivisions which trend in special directions.

The varieties of secondary education in the former of these main divisions would have to be determined generally by considerations of age. There must be different courses of study for those whose education is to terminate at sixteen, at eighteen, and at twenty-two or twenty-three. Within each of these divisions, also, there would be at least two types of instruction, mainly according as the student devoted himself chiefly to literature and language, or to mathematics and science. But a general characteristic of all secondary schools is that their express aim is much more individual than that of the primary school; it is to develop the potential capacity of each individual scholar to the highest point, rather than to give, as does the elementary school, much the same modicum to all. For these rea-

* Opening Address at the Glasgow Meeting of the British Association by the Right Hon. Sir John E. Gorst, F.R.S., President of Section L.

sons it is essential to have small classes, a highly educated staff, and methods of instruction very different from those of the primary school. In the formation of character the old secondary schools of Great Britain have held their own with any in the world. In the rapid development of new secondary schools British public school life should be introduced and maintained. It is not unscientific to conclude that the special gift of colonizing and administering dependencies, so characteristic of the people of the United Kingdom, is the result of that system of self-government to which every boy in our higher public schools is early initiated. But while we boast of the excellence of our higher schools on the character-forming side of their work, we must frankly admit that there is room for improvement on their intellectual side. Classics and mathematics have engrossed too large a share of attention; science, as part of a general liberal education, has been but recently admitted, and is still imperfectly estimated. Too little time is devoted to it as a school subject; its investigations and its results are misunderstood and undervalued. Tradition in most schools, nearly always literary, alters slowly, and the revolutionary methods of science find all the prejudices of antiquity arrayed against them. Even in scientific studies, lack of time and the obligation to prepare scholars to pass examinations cause too much attention to be paid to theory, and too little to practice, though it is by the latter that the power of original research and of original application of acquired knowledge is best brought out. The acquisition of modern languages was in bygone generations almost entirely neglected. In many schools the time given to this subject is still inadequate, the method of teaching antiquated, the results unsatisfactory. But the absolute necessity of such knowledge in literature, in science, and in commerce is already producing a most salutary reform.

The variety of types of secondary instruction demanded by the various needs and prospects of scholars requires a corresponding variety in the provision of schools. This cannot be settled by a rule-of-three method, as is done in the case of primary instruction. We cannot say that such and such an area being of such a size and of such a population requires so many secondary schools of such a capacity. Account must be taken in every place of the respective demands for respective types and grades of secondary education; and existing provision must be considered.

It must not, however, be forgotten that a national system of education has its drawbacks as well as its advantages. The most fatal danger is the tendency of public instruction to suppress or absorb all other agencies, however long established, however excellent their work, and to substitute one uniform mechanical system, destructive alike to present life and future progress. In our country, where there are public schools of the highest repute carried on for the most part under ancient endowments, private schools of individuals and associations, and universities entirely independent of the government, there is reasonable hope that with proper care this peril may be escaped. But its existence should not be forgotten. Universal efficiency in all establishments that profess to educate any section of the people may properly be required; but the variety, the individuality, and the independence of schools of every sort, primary and secondary, higher and lower, should be jealously guarded. Such attributes once lost can never be restored.

There still remains for our consideration the second division of higher education, viz., the applied or technological side. It is in this branch of education that Great Britain is most behind the rest of the world; and the nation in its efforts to make up the lost ground fails to recognize the fact that real technical instruction (of whatever type) cannot possibly be assimilated by a student unless a proper foundation has been laid previously by a thorough grounding of elementary and secondary instruction. Our efforts at reform are abrupt and disconnected. A panic from time to time sets in as to our backwardness in some particular branch of commerce or industry. There is a sudden rush to supply the need. Classes and schools spring up like mushrooms, which profess to give instruction in the lacking branch of applied science to scholars who have no elementary knowledge of the particular science, and whose general capacities have never been sufficiently developed. Students are invited to climb the higher rungs of the ladder of learning who have never trod the lower. But science cannot be taught to those who cannot read, nor commerce to those who cannot write. A few elementary lessons in shorthand and bookkeeping will not fit the British people to compete with the commercial enterprise of Germany. Such sudden and random attempts to reform our system of technical education are time and money wasted. There are grades and types in technological instruction, and progress can only be slow. It is useless to accept in the higher branches a student who does not come with a solid foundation on which to build. In such institutions as the Polytechnics at Zurich and Charlottenburg we find the students exclusively drawn from those who have already completed the highest branches of general education; in this country there is hardly a single institution where this could be said of more than a mere fraction of its students. The middle grades of technological instruction suffer from a similar defect. Boys are entered at technical institutions whose only previous instruction has been at elementary schools and evening classes; whose intellectual faculties have not been developed to the requisite point; and who have to be retaught the elements to fit them for the higher instruction. In fact there is no scientific conception of what this kind of instruction is to accomplish, and of its proper and necessary basis of general education.

Yet this is just the division of higher education in which public authority finds a field for its operations practically unoccupied. There are no ancient institutions which there is risk of supplanting. The variety of the subject itself is such that there is little danger of sinking into a uniform and mechanical system. What is required is first a scientific, well-thought-out plan and then its prompt and effective execution. A proper provision of the various grades and types of technological instruction should be organized in every place. The aim of each institution should be clear; and the intellectual equipment essential for admission to each should be laid down and enforced. The principles of true economy, from the national point of view, must not be lost sight of. Provision can only be made (since it must be of the highest type to be of the slightest use) for those really qualified to profit by it to the point of benefiting the community. Evening classes with no standard for admission and no test of efficiency may be valuable from a social point of view as providing innocent occupation and amusement, but they are doing little to raise the technical capacity of the nation. So far from "developing a popular demand for higher instruction," they may be preventing its proper growth by perpetuating the popular misconception of what real technical instruction is, and of the sacrifices we must make if our people are to compete on equal terms with other nations in the commerce of the world. The progress made under such a system would at first be slow; the number of students would be few until improvements in our systems of primary and secondary instruction afforded more abundant material on which to work; but our foundation would be on a rock, and every addition we were able to make would be permanent, and contribute to the final completion of the edifice.

It is the special function of the British Association to inculcate "a scientific view of things" in every department of life. There is nothing in which scientific conception is at the present moment more urgently required than in national education; and there is this peculiar difficulty in the problem, that any attempt to construct a national system inevitably arouses burning controversies, economical, religious, and political. It is only a society like this, with an established philosophical character, that can afford to reduce popular cries about education (which ignore what education really is, and perpetuate the absurdity that it consists in attending classes, passing examinations, and obtaining certificates) to their true proportions. If this Association could succeed in establishing in the minds of the people a scientific conception of a national education system, such as has already been evolved by most of the nations of Europe, the States of America, and our own colonies, it would have rendered a service of inestimable value to the British nation.

A NEW GOLD FIELD.

LONG caravans of covered wagons, or prairie schooners, in the Western vernacular, may be seen trekking southward from this place. If one arrives here early in the morning you find the stage coach going into the Wichita Mountains already filled, and if one hurries, nothing is left to do but hire a private conveyance. For the rush to the gold fields of the Wichita Mountains has commenced in earnest. A fresh Klondike is said to be springing up in these mountains of the new country—the Kiowa and Comanche Indian reservations.

Gold, copper, oil—these three minerals may be found in many places round about here, but if in paying quantities has not been definitely established. Until the results of certain assays are fully known the rush will continue. If the gold is here in paying quantities the rush will equal that to the Klondike; if the gold does not pay the rush will not grow, but remain the same. At present several hundred persons are entering the mountains daily, searching for gold, while but few are coming away again. There are at present 6,000 mineral claims taken, with but half that number left vacant. The remaining ones will not last long, hence the rush is growing equal to that of the free-land opening just completed.

For three years past there have been certain old miners from California and Colorado who prospected for gold in the mountains of Oklahoma. What they found will never be known. Some have gone away and are said to be living in luxury in other States, others remain and guard zealously the claims which they are working. If they are taking out gold in paying quantities they do not seem anxious that it should become known. But they are getting money some way, for an old miner is not going to stay on a bit of land three years unless he is getting at pay dirt.

The tales that are told about the gold discoveries in the Wichita Mountains are so conflicting that one can hardly say whether the rush to them may ever prove worth while or not. I traveled thirty miles south into the range supposed to be producing gold. It was a long, hot ride through the Wichita Valley. Passing through the new country just opened to settlement, one could hear wild stories of gold strikes, oil gushers, and what not. I found several hundred prospectors camped at Park City, at the foot of Saddle Mountain. There were stores in tents, gambling houses, saloons, and every evidence of a prosperous camp. I went up the mountainside. In a ravine I found two old miners digging.

"Have you found gold?" I asked.

After learning that I was not seeking any mineral claim for myself, these men started to tell me the story of the gold hunt. One was Sam Parks, who formerly owned an interest in the Emma gold mine at Aspen, Col., the other a veteran from California. They had worked their claim for three months and in the meantime had removed only eight tons of dirt and ore. From this the assayist had returned to them about $3,000. They showed me the gold dust. It was tied up in a buckskin bag. It was all sufficient to start a Klondike rush, and I asked these men why they kept their discovery under cover—that is, why did they not exhibit their find to the camp?

"We are afraid of the Indians in the first place, and, again, we do not want a crowd here, for we expect to work other mines. There is dirt here that will pay big money, and when we locate that we will give up this trifling claim, stake out the richest part, and let them know about it."

In a three days' tramp through the mountains I found this to be the general opinion among all the mine workers. They were taking out dirt paying from $100 to $800 per ton, but they wished for a better strike. Some, in fact all, the prospectors now at work think that a vein of gold and copper equaled only by the Klondike and Cape Nome finds exists in these mountains, if they can but find it. I met a man in Park City who told me he was offered $75,000 for his mineral claim in the Saddle Mountain district. He was well known in the camp, and it was claimed he had taken a half of that amount out in pay dirt. I doubted his word and asked him to show me the mine. He refused. Why, I could not learn, but there seems to be an air of mystery and secrecy surrounding the whole affair. Having been pursued so long by officers, the miners are still wary of strangers, is the reason the best informed offer.

It was not until August 6 that anyone was legally allowed to prospect for gold in these mountains, but even prior to that time about 2,000 claims had been staked. Some were worked for years back, and, as before stated, not all without bringing good fortune to the prospectors. Not a few half and quarter-blood redskins have taken out lumps of gold and traded them in the stores at Mountain View for cash. Of course, the gold lacked 50 per cent of being pure. The storekeepers profess no surprise when they are given a lump of ore to send off for assaying purposes. In fact, two-thirds of the miners pay that way. These specimens are sent East. The cash is returned to Mountain View, then transported to the mining camps. The Oklahoma Mechanical and Agricultural College has assayed some gold ore taken from the mountains south of here and officially reported it to be worth from $80 to $800 per ton. E. M. Tucker, of Granite, who owns a smelter, is doing a rushing business in his line. Mineral claim attorneys are coming into Mountain View every day, and hardly a store is without a sign reading something like this: "Mining Claims Located. Townsite Companies Managed."

Seven or eight town-site companies have been laid out and town lots sold. The town of Wildman has a post office. Park City has petitioned for one, and Mineral City is scraping together 200 voters, so it can do likewise.

Granite is the typical Dawson City of the Wichita gold excitement. It is on the branch line of the Rock Island Railway, and can be reached from the main line of that road by stopping off at Chickasha, I. T. The trail from Granite to the mountains is worn deep. Every Saturday night the miners strap their gold dust, or whatever else they have found the past week, into a bag, hit the trail for Granite or some other mining camp, and one can see a true representation of wild life until they go back into the hills again. Not a night passes but that some one is shot in a saloon fight, gambling games are run wide open, and trouble is hanging around waiting for every one. The typical miner of these mountains is the same as of old. One sees but few tenderfeet so far from the rushers. A great many of those disappointed in the land opening are entering the mountains in hopes of getting gold. Every day men grow disgusted with the overdone conditions of business at Lawton, Anadarko, and other of the new towns, and pack up their tents and go to the mountains. The trails are all covered with a rushing mass of humanity. The hills are dotted with men swinging a pick over one shoulder with one hand and carrying a grub basket in the other. Women are as yet unknown among the ranks of the gold seekers.

As in all other rushes, there are those highly skeptical about the existence of gold. All who have ever visited the mountains and know anything at all about mining say that copper exists, and perhaps oil could be found in the foothills. There are a number of wells at Granite, and once, a few weeks go, a gusher boomed forth a stream 40 feet high, but only for a few minutes. It was shut down by the owners for some unknown purpose. It is said that the Rock Island Road has an interest in the oil fields around Granite, but the mountains are free for any who wish to enter and stake out a claim. A mineral claim consists of twenty acres, and one is required to put $100 worth of work on it every year for five years. Then you get a deed by paying $20 per acre. The place for filing on mineral lands is at Lawton, and the line in front of the booth is never a short one.

The Wichita Mountains run from east to west across the southern part of the Kiowa and Comanche country. They are not over 2,000 feet high in any place, but are quite picturesque and rugged. Government experts have stated, after an examination, that gold and silver, also copper and oil, could be found in and around the mountains, but as to paying quantities they were uncertain. It is quite sure, from the manner in which prospectors are rushing into the hills, that something will happen soon. The excitement will either collapse or grow. A majority seem to think it will grow, and the storekeepers and stage lines are making ready for even a greater rush than now.

The mountains abound with small streams, and it is along the banks of these that gold exists. These mountain pools abound with trout, the timber is filled with small game and some deer, hence to investigate the gold deposits also helps one to enjoy a very pleasant outing. One or more government parks have been laid out near Fort Sill, and the miners are kept out of these by the soldiers. But few of the mountain peaks have been named. Saddle Mountain, which is said to be the richest in gold deposits, is so named for the reason that it has a true representation of a saddle when seen at a distance of forty miles. Trees are growing along the sides of most of the peaks, but some are entirely bared. In these mountains and around the foothills some of the most bloody battles in Indian history have been fought. At the base of one peak—Cut Throat Mountain—the Cheyennes and Osages engaged each other some forty years ago. Every Cheyenne of the 200 was captured and his throat cut. The Kiowas then came to the rescue of the Cheyennes, and many of them suffered the same fate. It was not until Big Bow, now living near here, shot an Osage medicine man dead that the trouble ended. The Kiowas applied the name of Cut Throat people to the Osages, and the mountain gradually assumed the same name.

I spent a Sunday at Park City. The rush was at its height. In the wagon with me came ten hardy miners. They brought supplies for a month's outing. They pushed into the hills at once. The miners who came down the mountain side around about dusk on Saturday evening were grizzled veterans whose faces had not seen a razor for weeks. But their pockets bulged

with ore. Red dirt was ground in their skin; their boots looked as though pay dirt had been rubbed against them for weeks. The miners spent money like princes. It was a great soiree they had in the tented saloon that night spinning yarns about big strikes, rich claims yet untaken, what a rush there would be before six months, and so on. Every one seems confident that the future will bring forth rich strikes. Their present work they consider but little, and yet it is one of the greatest rushes ever made for a gold field in the Southwest. Fully 20,000 persons have been into the mountains since the opening. Six thousand claims are staked. Many mining camps are taking on life. The Wichita Mountains have begun to draw like the Klondike.—W. R. Draper, Mountain View, Oklahoma, in the New York Times.

THE VENTILATION OF TUNNELS.

THE ventilation of tunnels has always been an important problem for consideration, and has attracted special attention since an accident that happened in Italy a few years ago, when a train was forced to stop for some time in the middle of a tunnel, with the result that a man lost his life through defective ventilation and the disengagement of noxious gases.

The question was then asked on all sides whether natural ventilation alone, which had been applied up to that time, was really adequate. It was remarked, in fact, that since the increase in traffic it had often happened that the renewal of the air was imperfectly effected, and that accidents were to be apprehended.

M. Saccardo, inspector-in-chief of the railways of Italy, devised the first system of ventilation, which was applied in what is called the "Apennine Tunnel," upon the line from Bologna to Pistoja.

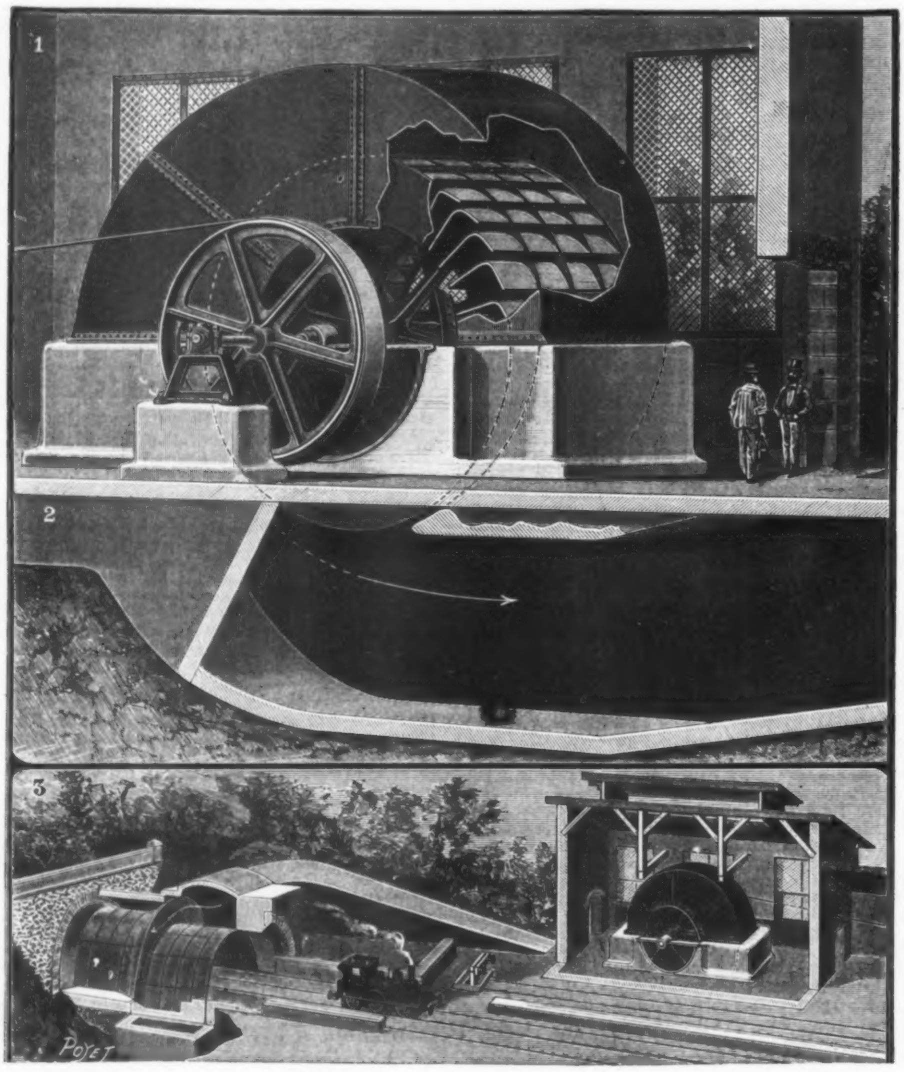
According to a paper by M. L. Champy, published in the Annales des Mines, the length of this tunnel is 16.4 miles, with a continuous gradient of 0.3 of an inch to the foot in a straight line with the exception of a curve of about 1,600 feet radius and a length of 1,300. It has a single track, and a section of 248 square feet, with a perimeter of 60.75 feet. It is in the center of a mountain, near a summit where violent winds often annul the current of natural air. The conditions of exploitation from the viewpoint of combustion and that of the personnel were of the worst character.

The Saccardo apparatus is installed at the uppermost orifice of the tunnel, and is so arranged as to direct the current of air against the ascending trains. It consists of an annular chamber placed at the head of the tunnel and connected with the gallery of a ventilator, and is prolonged into the tunnel in front. The external lateral walls are of masonry. The covering, the connection with the gallery and the internal lateral walls are of woodwork. The ventilator, which is of the Ser type, has a diameter of 16 feet. This installation has been submitted to a large number of experiments and its operation found to be satisfactory. In the meantime a committee of Italian railway engineers has determined the least volume of air to be discharged in order to assure a perfect ventilation.

For the same reasons of security the Paris-Lyons-Mediterranean Railway recently resolved to ventilate the Albespeyre single-track tunnel, upon the line from Nimes to Saint-Germain-des-Fossés, and of a length of 4,800 feet, by a process analogous to that of M. Saccardo. To this effect M. E. Farcot has constructed a ventilator 19.6 feet in diameter and capable of furnishing 5,250 cubic feet of air an hour at a pressure of 1.6 inch of water. This apparatus is 8.2 feet in width and is provided with buckets four in a row. At the entrance to the tunnel is adjusted a metal ring filled with air, and provided with nozzles that project the latter into the tunnel.

The two cities of Liverpool and Birkenhead have for some time been connected by a steam railway that passes through a submarine tunnel. This latter has always been filled with smoke and soot, and the air of it has been irrespirable. The British Westinghouse Electric Company in order to obviate the difficulty has preferred to do away with steam traction and to substitute electric traction therefor.

It results from the observations made almost everywhere that by reason of the general increase in the requirements of a service that is more and more overburdened there will be reason in a near future to modify the present method of natural ventilation of long tunnels. It will become necessary to have recourse to mechanical ventilation to multiply, whenever possible, the number of draught chimneys, or, finally, to adopt electric traction for the traversing of tunnels if circumstances are favorable thereto.—For the above particulars and the illustration we are indebted to La Nature.



VENTILATION OF TUNNELS.

1. The Farcot Ventilator. 2. Ventilating tunnel. 3. General view of the installation.

SMOKELESS FLASH-LIGHT.

THE magnesium flash-light powders commonly employed for photography make, as everyone knows, a very disagreeable cloud of smoke. M. Charles Henry has been experimenting with a view to doing away with this disagreeable feature. His results are communicated to La Photographie by M. L. P. Clerc, and are thus condensed in the Revue Scientifique: M. Charles Henry has endeavored to keep the magnesia that is formed as much as possible attached to a heavy substance that will not easily fly about, and falls soon by its own weight, namely, the binoxide of barium. This substance, at a red heat, gives up half of its oxygen, and its salts communicate to flames a brilliancy of greenish fire, which partially corrects the undue proportion of violet and ultra-violet rays emitted by incandescent magnesia. Finally the binoxide swells when heated, and becomes capable of retaining the light powder of magnesia formed in contact with it. The sole condition to be observed, that the binoxide may be reduced with incandescence, is to remove it vigorously from all contact with oxygen. To this end, and also to insure the inflammability of the mixture, the powder is done up in collodion, whose products of combustion constitute a reducing atmosphere, adapted to the dissociation of the binoxide of barium at the lowest possible temperature. All the elements of such a powder thus play an active part at the highest point. These powders have besides a great advantage over those made of potassium chlorate; they are absolutely inexplodable by the stroke of a hammer, and are inodorous and without danger from the physiological point of view. M. Henry, we are told, has prepared two types of powder that differ in their proportions of the binoxide—the first, which has only a little magnesium, gives only 45 to 50 per cent of smoke, whereas ordinary powders give 75 to 90 per cent. The other is richer in magnesium, burns more slowly, and can be used advantageously only in a special lamp, when the proportion of smoke falls as low as 10 per cent, and the brilliancy, owing to the high temperature to which the magnesia is raised, is very great.

A BRIEF COMPARISON OF RECENT BATTLESHIP DESIGNS.

By NAVAL CONSTRUCTOR H. G. GILLMOR, U. S. N.

THERE is probably no class of design work in which what is to be done is so largely controlled by what has been done, and what is being done, as in the designing of naval vessels. The value of any vessel for naval purposes must necessarily be determined finally not only by the features embodied in the vessel itself, but by the characteristics of the vessels against which she may be opposed. It is this which makes the study of the development of foreign designs a necessity, and determines the characteristics of the vessels of the several classes which may at any time be in course of design.

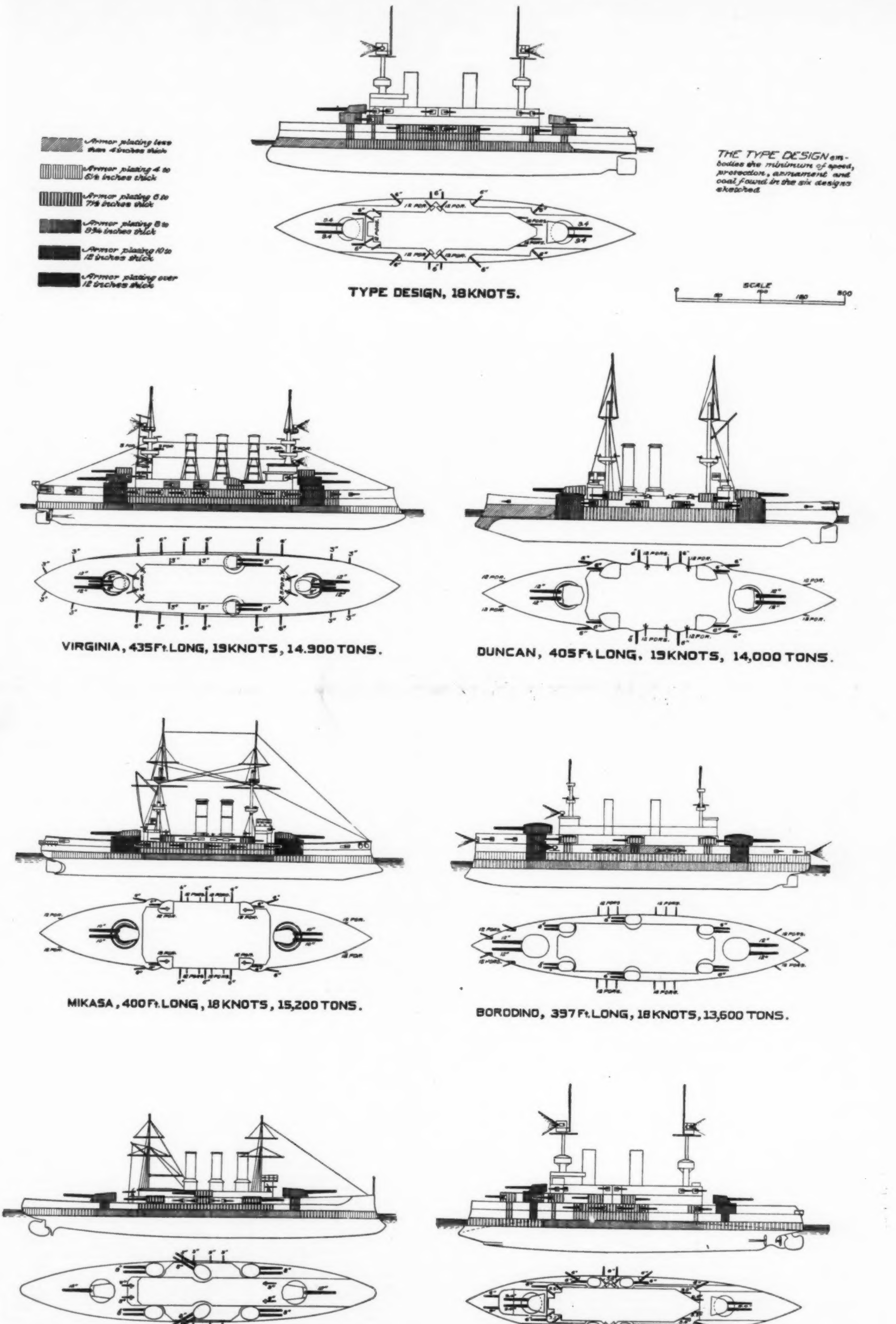
While from time to time new types of vessels have been introduced and developed, there has always been a type of vessel recognized in each period as the main strength and backbone of naval force; and this type has always been designated the battleship. It is to the consideration of the designs of vessels of this class of the present period that attention is asked. For the purposes of comparison there have been chosen the most recent designs of the several principal naval powers; and the comparison will be confined to the design conditions for those features which directly contribute to the naval value of each unit—that is to say, the armament, the protection, the speed, and the coal supply. The designs chosen are Great Britain, the "Duncan"; Germany, the "Wittelsbach"; Russia, the "Borodino"; Italy, the "Vittorio Emanuele"; Japan, the "Mikasa," and the United States, the "Virginia." In each case there are represented two or more vessels, the naval features of which are virtually the same as that of the vessel named. The information available with respect to the latest French battleship design is so meager as to have made it impracticable to include it in the comparison proposed.

In the engraving small-scale sketches, showing these vessels in elevation and deck plan, are given with the purpose of presenting visually the differences in naval features among them. Full data is given in the tabular statement in Table I. which follows.

Even to the casual observer considerable variation in the design features must be noticeable; and since this variation may be taken as an indication of the range within which designers of the present have considered it advisable to limit these elements, a brief notice of them may not be without value.

In armament, uniformity of practice is found in the location of the heavy guns, but in their number and caliber a considerable range is noticeable. With but two exceptions 12-inch guns have been chosen, and, with a single exception, the number of heavy guns is four, mounted in pairs, two forward and two aft. In the "Mikasa," four 10-inch guns make up the heavy battery, though in other vessels of practically the same general characteristics built for the Japanese government, 12-inch guns have been employed. In the "Wittelsbach" design, four 9.4-inch guns have been adopted, marking the limit in lightness of caliber of the first-caliber guns in battleships. The one exception to the number four for the heavy guns is in the "Vittorio Emanuele," where two 12-inch guns, mounted one forward and one aft, have been chosen. In the guns of second caliber an almost equal range in caliber and a considerable variation in arrangement are noticeable. In all but two of the designs under consideration what may be called a central battery, more or less extended, is employed. This central battery reaches the extreme of concentration on the "Wittelsbach," and is most extended on the "Virginia." In two out of the six designs the secondary caliber guns are mounted exclusively in such a central battery, with the addition of four guns of second caliber in isolated casements, giving bow and stern fire. In two others, in addition to the central battery, a portion of the second caliber guns are mounted in turrets, giving fire over a considerable arc from directly ahead or directly astern. In these turrets there are, in one case, guns mounted in pairs, and, in the other, single guns. The "Borodino" and "Vittorio Emanuele" mount the second caliber guns entirely in such turrets. In the "Wittelsbach," the central battery, isolated casemates and turrets for the second-caliber guns, are used in combination. In the choice of a caliber for second-caliber guns, 8-inch guns and 6-inch guns divide honors. In the "Vittorio Emanuele" the second-caliber guns are 8-inch guns. In all the others, with the exception of the "Virginia," the second-caliber guns are 6-inch guns. In the "Virginia" both 8-inch and 6-inch guns are employed. The number of guns of second caliber varies from twelve 6-inch in the "Duncan" to twelve 6-inch and eight 8-inch in the "Virginia." In the secondary battery also there is considerable variation in the number and caliber of the guns, the arrangement being dependent upon the system employed in mounting the second-caliber guns. The caliber ranges from 15-pounders and 1-pounders in the "Wittelsbach" to 12-pounders and 3-pounders in the "Duncan"; and, in numbers, from forty in the "Borodino" to eighteen in the "Duncan."

In the matter of protection to stability by a waterline belt, a considerable range is noticeable. The lower limit is found in the "Duncan," in which two-thirds of



COMPARISON OF RECENT BATTLESHIP DESIGNS.

TABLE I.

	Virginia.	Duncan.	Borodino.	Mikasa.	Wittelsbach.	Vittorio Emanuele.	Type Design.
Laid down	1901	1899–00	1900	1899	1899–00	—	—
Length between perpendiculars	435′	405′	397′	400′	418′	435′	435′
Breadth, moulded	76′ 10″	75′ 6″	76′ 0″	76′ 0″	68′ 0″	73′ 6″	76′ 0″
Draught, mean	24′ 0″	26′ 6″	26′ 0″	27′ 2″	25′ 0″	25′ 7″	—
Displacement, in tons	14,950	14,000	13,600	15,200	11,800	12,624	—
Indicated H. P. with forced draught	19,000	18,000	16,000	15,000	15,000	19,000	—
Speed, in knots, with forced draught	19.0	19.0	18.0	18.0	19.0	22.0	18.0
Boilers	Various.	Belleville.	Belleville.	Belleville.	Cyl. & Schultz.	—	—
Armament:							
Main battery	4–12″	4–12″	4–12″	4–10″	4–9.4″	2–12″	4–9.4″
	8–8″	12–6″	12–6″	14–6″	18–6″	12–8″	12–6″
	12–6″	—	—	R. F.	R. F.	—	—
Secondary battery	12–3″	12–12 pdrs.	20–12 pdrs.	20–12 pdrs.	12–3.5″	12–3″	12–12 pdrs.
	3–3 pdrs.	6–3 pdrs.	20–3 pdrs.	8–3 pdrs.	12–1 pdrs.	12–1.8″	6–3 pdrs.
	8–1 pdrs.	—	4 Maxim.	4–2½″	—	—	—
Torpedo tubes:							
Above water	—	—	4	—	1	4	—
Submerged	2	4	2	4	5	—	2
Protective deck:							
Thickness of slopes	3″	1″	2½″	2″	3″	4″	3″
Thickness of horizontal parts	1½″	2″	1½″	—	1½″	2″	1½″
Armor:							
Length of water-line belt	Whole length.	⅔ length.	Whole length.	Whole length.	Whole length.	Whole lg'th	⅔ length.
Breadth of water-line belt	8′ 0″	7′ 0″	6′ 6″	7′ 9″	7′ 0″	—	7′ 0″
Thickness of water-line belt, amidships	11.8″	7″	8″	9″	8.8″	9¾″	7″
Thickness of water-line belt at ends	4″	2″	5¾″	4″	4″	4″	2″
Bulkheads	6″	7″	—	6″	6″	6″	6″
Length of upper belt	⅔ length.	⅔ length.	Whole length.	⅔ length.	¼ length.	½ length	¼ length.
Width of upper belt	—	7′ 0″	5′ 6″	7′ 6″	7′ 6″	7′ 6″	7′ 6″
Thickness, upper belt	6″	7″	6.4″	6″	6″	6″	6″
Protection, largest guns	10″	11″	10″	14″	10″	8″	8″
Protection, medium caliber guns	6″	6″	6″	6″	6″	6″	6″
Protection, other guns	2″	—	3″	—	—	—	—
Conning tower, forward	9″	12″	—	14″	10″	10″	9″
Conning tower, after	5″	3″	—	3″	6″	—	3″
Coal supply, normal	900	900	900	1,400	650	1,000	650
Coal supply, bunkers full	1,900	2,000	1,500	2,000	1,250	2,000	1,250

the length of the vessel is protected by a belt of a thickness of 7 inches, the forward end being protected from the fire of secondary battery guns by 2-inch nickel steel plating riveted upon the skin plating—as in protective decks. The remaining five vessels under consideration have, for stability protection, complete water-line belts, the maximum thickness of which is found in the "Virginia"—11 inches at top of armor amidships, tapering to 8 inches at the bottom. The lower limit in the extent of the upper belt, affording protection to the ammunition supply for the battery, is found in the "Wittelsbach," where this belt is limited to about one-fourth of the length of the vessel. Three of the vessels under consideration, namely, the "Virginia," the "Duncan," and the "Mikasa," carry this upper belt over about two-thirds of the length. The "Vittorio Emanuele" has an upper belt over somewhat more than one-third its length, and the "Borodino" for the whole length. It should be mentioned, however, that in the "Borodino" both the water-line belt and this upper belt are so narrow that the two combined really make a wide water-line belt over the whole length of the vessel. The thickness of the armor employed for this upper belt is uniformly 6 inches, except in the case of the "Duncan," in which the water-line belt and upper belt are continuous and 7-inch armor is employed.

In the character and extent of the protection to the guns of first caliber, the greatest range is noticeable. The lower limit of such protection is found in the "Vittorio Emanuele," where 8-inch armor is employed, and restricted armored tubes with walls of equal thickness, for protection to the ammunition supply. From this the degree of protection ranges upward, as may be readily observed from the figures in the engraving, the maximum being found in the "Mikasa," in which there are barbettes 14 inches in thickness extending at their full diameter to the top of the water-line belt.

The protection adopted for the guns of second caliber is uniformly 6-inch armor throughout all the designs under consideration. The method of disposing this armor for the protection of the guns varies. In three of the six ships there are central batteries, concentrated in the "Wittelsbach" and extended in the "Virginia" and "Mikasa." In addition to this central battery the "Wittelsbach" and "Mikasa" employ, also, isolated casemates with 6-inch armor for a portion of the guns of second caliber; and, in the "Duncan," this system of protection exclusively is employed for the second-caliber guns. Upon the "Vittorio Emanuele" and "Borodino," the second-caliber guns are all carried in armored turrets, with 6-inch armor, and, in the "Wittelsbach" and "Virginia," such turrets are combined with central batteries, or with central batteries and casemates. The exceptional features in protection and system of mounting in the superposition of 8-inch turrets upon 12-inch turrets in the "Virginia," have been the subject of so much discussion as to make special comment unnecessary. The "Borodino" and "Virginia" are the only vessels in which any protection is provided for guns of the secondary battery.

The speed adopted for two of the vessels is 18 knots. In the "Virginia," "Duncan," and "Wittelsbach," the designed speed is 19 knots. In the "Vittorio Emanuele" the speed feature is developed to an extent which separates this vessel widely from the others under consideration. Her speed of 22 knots, if realized, would practically place her on an equal footing, as to speed, with the armored cruisers being constructed by several of the naval powers. There seems reason to doubt the accuracy of report as to the speed feature of this vessel, regard being given to the other features proposed.

The lower limit in the coal supply in the designed condition is found in the "Wittelsbach," the design of which provides for a normal supply of 650 tons, with a maximum stowage capacity of 1,250 tons. From this the normal coal supply ranges through 900 tons for the "Borodino," "Virginia," and "Duncan," 1,000 tons for "Vittorio Emanuele," to a maximum for this element of 1,400 tons in the "Mikasa."

The variations which have been pointed out make direct comparison of the several vessels difficult. To establish a basis for the present comparison, it is proposed to assume a vessel whose dimensions are those of the largest vessel under consideration, in which the features of armament, protection, speed, and coal supply embodied are the minima of these several features, which may be found among the designs under discussion. Such a vessel would represent the extreme limit to which, as judged from current practice, it is thought possible to reduce the several elements, and will be designated a *type design*.

This *type design* will then be a vessel of about 435 feet in length and 76 feet in breadth (about the extreme dimensions of the "Virginia" class), having a speed of 18 knots (the speed of the "Mikasa" and "Borodino"); with a normal coal supply of 650 tons (that of the "Wittelsbach"); a battery of four 9.4-inch guns (the first-caliber battery of the "Wittelsbach"), and twelve 6-inch guns, twelve 12-pounder and six 3-pounder guns (the second-caliber guns and secondary battery of the "Duncan"); two torpedo tubes (as in the "Virginia"); a water-line belt 7 inches thick and 7 feet wide, extending from the after barbette for two-thirds of the length of the vessel, with 2-inch nickel steel plating carried from the forward end of this belt to the stem (the water-line protection of the "Duncan"); surmounted by a shorter belt 6 inches in thickness, inclosed by bulkheads at its ends of the same thickness, extending up to the top of the gun deck to form a protected battery (as on the "Wittelsbach"); the 9.4-inch guns and ammunition supply protected by barbettes and ammunition tubes, carrying armor 8 inches in thickness (the protection of the first-caliber guns of the "Vittorio Emanuele"); and the 6-inch guns and ammunition supply protected by 6-inch armor (the protection of the second-caliber guns provided in all of the designs under consideration). It has been necessary to assume that the protective decks in the several designs under consideration are of practically equal value as protection, and that the type design has an equivalent protective deck. A sketch outline of the elevation and deck plan of this type design will be found at the top of the engraving, and detailed data relative to her several features, in the last column of the foregoing table, Table I.

To attempt to express in figures an absolute or relative naval value, even for vessels of the same class, is generally regarded as almost impracticable, because of the impossibility of suitably assigning values among the several design elements, all contributing to a successful whole and differing so widely in their individual purposes as to be practically incomparable. Since, however, such an expression of value, even if only very approximately correct, affords a means of giving point to a comparison, an effort will be made to reduce the present comparison to such terms as will permit the assignment of approximate relative values. The results, depending as they do upon so many things which, at best, can be but inaccurately known to any but the designer of each vessel, must, of course, be regarded as qualified by the inaccuracies in the data upon which such results depend.

It may fairly be assumed that the naval value of any vessel at a given period depends chiefly upon the battery carried; the protection given to stability, armament, ammunition supply and personnel; the speed; and the time during which she may operate without interruption, as measured by her coal supply. Her naval value, therefore, is independent of her displacement, although there is a relation between that naval value and displacement which fixes the limit of naval value which may be reached upon any displacement, and the excellence of any design should be judged by the nearness of the approach of that design to this limiting relation.

Such a vessel as the type design outlined above has, for naval purposes, a definite value, which might be expressed in a variety of ways. Each of the several vessels whose designs it is proposed to compare may be regarded as being such a vessel as the type design, upon which improvements of value have been introduced in one or more of the elements of armament, protection, speed, or coal supply. The designers of the several vessels under consideration, having provided for the minima of the several essential features of battleship design, have varied the distribution of the remaining disposable weight in a manner which each individually deemed most efficient. Since each of the several features may be found developed to an extreme in some one or more of the vessels being compared, and since the one restricting and governing condition in such development is weight, may it not fairly be assumed that the naval value, assignable to the excessive development of any one of the design features, may be represented by the weight necessary to such a development in any degree above that represented by a minimum embodied in all the designs. Such an assumption will here be made; and the naval value of the type design will be assumed to be 4,300, the approximate weight required, under the conditions outlined, to provide in the type design the features embodied. The relative naval value of each vessel under consideration, as compared with the type design, will be expressed finally by adding to 4,300, the naval value of the type design, the weight which it would be necessary to add to the type design in order to provide in that vessel for the armament, armor, speed, and coal carried in the design whose relative naval value it is desired to represent.

The several vessels, when compared with the type design, show increases in the several naval features, with corresponding added naval value as follows:

"VIRGINIA."

Four 12-inch guns instead of four 9.4-inch guns	Value	160
Eight 8-inch guns additional	"	350
Twelve 14-pounders instead of twelve 12-pounders, and two 3-pounders and eight 1-pounders additional	"	40
Heavier and more extended water-line protection (11-inch armor as compared with 7-inch armor amidship)	"	410
More extended upper belt	"	120
Heavy guns in turrets protected by 10-inch armor; Large diameter barbettes with 10-inch armor	"	620
Protection of 8-inch gun positions, and extended central battery protection	"	240
Protection to portion of secondary battery	"	40
Additional normal coal supply	"	250
One knot more speed, which, with weights added above, necessitates increase in machinery weights	"	520
Total additional value		2750
Value of type design		4300
Relative naval value		7050

"DUNCAN."

Four 12-inch guns instead of four 9.4-inch guns	Value	160
Two additional submerged torpedo tubes	"	20
More extended upper belt of greater thickness	"	350
Heavy guns mounted on turn-tables with barbettes protected by 11-inch armor	"	500
All second caliber guns in isolated armored casemates, affording additional protection to such guns	"	260
Additional normal coal supply	"	250
One knot more speed, which, with the weights added above, necessitates increase in machinery weights	"	450
Total additional value		2000
Value of type design		4300
Relative naval value		6300

"BORODINO."

Four 12-inch guns instead of four 9.4-inch guns	Value	160
Eight additional 12-pounders and fourteen additional 3-pounders	"	50
Four additional above water torpedo-tubes	"	30
Heavier and more extended water-line protection (9-inch armor as compared with 7-inch armor amidship)	"	100
More extended upper belt, complete	"	200
Heavy guns in turrets protected by 10-inch with large armored tubes	"	450
Protection to portion of secondary battery	"	120
Additional normal coal supply	"	250
With same speed, weights added necessitate increase in machinery weights	"	130
Total additional value	"	1490
Value of type design		4300
Relative naval value		5790

"MIKASA."

Four 10-inch guns instead of four 9.4-inch guns	Value	50
Two additional 6-inch guns	"	50
Eight additional 12-pounders, two additional 3-pounders, and four additional 2½-pounders	"	20
Two additional submerged torpedo-tubes	"	20
Heavier and more extended water-line protection (9-inch armor as compared with 7-inch armor amidship)	"	250
More extended upper belt	"	190
Heavy guns mounted on protected turn-tables, with large diameter barbettes protected by 14-inch armor	"	580
More extended central battery and protection to two additional 6-inch guns	"	190
Additional normal coal supply	"	750

TABLE II.

TABLE OF RELATIVE, ADDITIONAL, AND TOTAL NAVAL VALUE.

	Virginia.		Mikasa.		Vittorio Emanuele.		Duncan.		Borodino.		Wittelsbach.	
	Added value.	Totals.	Added value.	Totals.	Added value.	Totals.	Added value.	Totals.	Added value.	Totals.	Added value.	Totals.
Heavy guns and ammunition	160		50		—50		160		160		—	
Second caliber guns and ammunition	350		50		220		—		—		145	
Secondary battery guns and ammunition	40		20		20		—		50		10	
Torpedo outfit	—		20		30		30		30		25	
Total amount		550		140		220		190		240		180
Water-line protection	410		350		270		—		100		130	
Upper belt and bulkheads	120		190		80		350		200		—	
Protection to heavy guns	620		580		—		500		450		80	
Protection to second caliber guns	240		190		—160		260		—		240	
Protection to secondary battery	40		—		—		—		120		—	
Total protection		1,430		1,310		190		1,110		870		450
Coal supply	—	250	—	750	—	350	—	250	—	250	—	—
Speed	—	520	—	230	—	1,500	—	450	—	130	—	330
Total additional value		2,750		2,430		2,260		2,000		1,490		960
Value of type design	—	4,300	—	4,300	—	4,300	—	4,300	—	4,300	—	4,300
Relative naval value		7,050		6,730		6,560		6,300		5,790		5,260
Designed displacement	—	14,950	—	15,200	—	12,624	—	14,000	—	13,600	—	11,800
Efficiency of design	—	47.2	—	44.3	—	52.0	—	45.0	—	42.7	—	44.6

With same speed, weights added above necessitate increase in machinery weights	Value 230
Total additional value	2430
Value of type design	4300
Relative naval value	6730

"WITTELSBACH."

Six additional 6-inch guns	Value 145
15-pounders instead of 12-pounders	" 10
Additional torpedo outfit	" 25
Heavier and more extended water-line protection (8.8-inch armor as compared with 7-inch armor amidship)	" 130
Additional protection to heavy guns (10-inch armor as compared with 8-inch armor)	" 80
Armored casemates for two additional 6-inch guns and turrets for four additional 6-inch guns	" 240
One knot more speed, which, with weights added above, necessitate increase in machinery weights	" 330
Total additional value	960
Value of type design	4300
Relative naval value	5260

"VITTORIO EMANUELE."

Two 12-inch guns instead of four 9.4-inch guns	Value 50
Twelve 8-inch guns instead of twelve 6-inch guns	" 220
Twelve 14-pounders instead of twelve 12-pounders, and six additional 3-pounders	" 20
Additional torpedo outfit	" 30
Heavier and more extended water-line protection (9¾-inch armor as compared with 7-inch armor amidship)	" 270
More extended upper belt	" 80
Protection to second-caliber guns by turrets	" 160
Additional normal coal supply	" 350
Four knots more speed, which, with weights added above, necessitate increase in machinery weights	" 1500
Total additional value	2260
Value of type design	4300
Relative naval value	6560

In Table II. the several vessels will be found in the order of their relative values, and the values assigned to each of the several items are given in such a manner as to facilitate direct comparison of the distribution of weight among the several features.

It should be noticed that there is reason to believe that the figures for the indicated horse-power and displacement for the Italian vessel, "Vittorio Emanuele," are inaccurate, since, in the present state of shipbuilding art, it would seem to be impracticable to procure, with the horse power given, the designed speed of 22 knots in a vessel of the designed displacement of 12,624 tons; and this displacement would seem to be inconsistent with the features which, if report relative to this vessel be true, it is proposed to embody in the design. It should also be noticed that the feature of protection given by the protective decks of the several vessels is regarded as being of equal efficiency and value in all the vessels. It is known that in the "Borodino" this protective feature has been developed to an extent somewhat in excess of that found in the other vessels compared; and, had it been practicable to extend the comparison to include this feature, the "Borodino" would, doubtless, have shown to better advantage in the final results.

Since the relative naval values given above are expressed in terms of, mathematically, the same dimensions as those employed in the expression of displacement, if the relative naval values be divided by the designed displacements of the several vessels, the results may be expressed as a percentage, which might be termed the efficiencies of the several designs. These figures are given in the last line of Table II., and varying, as will be seen, from 42.7 per cent for the "Borodino," up to 52 per cent in the "Vittorio Emanuele" (assuming the designed displacement given for this vessel to be a possible one); and the order of merit of the designs would be, on this basis, as follows:

"Victorio Emanuele," 52.0.
"Virginia," 47.2.
"Duncan," 45.0.
"Wittelsbach," 44.6.
"Mikasa," 44.3.
"Borodino," 42.7.

In conclusion, it may be stated that while reasonable care has been given to the estimates upon which they are based, detailed accuracy in the figures given above is not claimed. The purpose has been to roughly estimate and express in concrete terms the relative naval values of the several vessels whose designs were considered, in order that the results of this comparison might be presented in a form more tangible than that of a general discussion of the several features of the designs.

HIGH-TENSION SWITCHES.*

By E. W. RICE.

IT is evident that great advances in the capacity and voltage of generators would be useless, if not positively dangerous, unless adequate means for controlling and switching the electrical current were at hand. The evolution of the dynamo was for a time more rapid than that of the devices for controlling and switching currents of large volume and potential. As a result, a number of machines of large size were placed in operation with comparatively inadequate methods of switching and controlling. The energy and power which can be safely concentrated in a single central station is obviously limited by the amount of current and voltage which switching devices can safely handle. This fact was especially forced upon the attention of the writer at the time when the company with which he is connected took the contract for the equipment of the generating station of the Metropolitan Traction Company, New York. This station was to contain 11 three-phase dynamos, each of 3,500 kilowatts output at 6,600 volts. In order to realize the full economy of such a station, it was, of course, necessary that all the generators should supply current to a common 'bus bar, and that from these 'bus bars the current should be distributed through feeders to a number of substations. The sub-stations were to contain rotary converters, frequently working in multiple with large storage batteries on the direct-current side. The characteristics of such a load prevented any reliance being placed upon the opening of the exciting circuit of the generators in case of the necessity of a general shutdown, as the rotary converters would, under certain conditions, supply sufficient magnetizing current to excite the generators, even with the field windings of the generators unexcited. It became, therefore, essential to produce a switching mechanism which would enable the generators to be connected and disconnected from the 'bus bars with certainty and safety under all conditions of load, even up to a short circuit, and also that the various feeders supplying the sub-station should be capable of the same treatment. Three types of switching devices were available for this work, and were carefully considered:

1. Switches breaking the circuit in the open air.
2. Switches arranged to break the circuit in an inclosed air space.
3. Switches arranged to break the circuit under oil.

Switches of the first type (open air) were impracticable, because the space demanded to make such switches operative could not be provided.

Switches of the second type (inclosed air) had no such limitation, but oil-break switches were found to meet the conditions more perfectly. Tests conducted showed that energy of 2,000 kilowatts to 3,000 kilowatts could be controlled in a single oil switch at potentials as high as 15,000 volts, which was the limit of the apparatus at our disposal at the time. Switches of this type, however, as large as were considered necessary, required an amount of oil per switch so great as to be objectionable, in view of the large number of switches required for generators and feeders. The problem, then, was to produce a switch which would retain all the advantages of the usual oil-switch, and at the same time minimize the quantity of oil. The type which was finally evolved and employed in the Metropolitan installation has shown itself in practice to be remarkably successful. It is known as the form "H" oil switch by the manufacturers, and was designed by the writer, with the assistance of Mr. E. M. Hewlett.

The switch, as designed for three-phase circuits, consists of three double-pole single-phase switches or elements. Each single-phase switch is contained in a fireproof cell, but all three switches are designed to be operated simultaneously. Each single-phase element consists of two brass cylinders or cans, one can for each pole. The incoming lead is attached to one of the cans and the outgoing lead of the same phase to the other. Each cylinder is nearly filled with oil and is covered by a metal cap, which carries a long insulating sleeve. Two copper rods joined by a metallic cross-head and forming together a U-shaped conductor, slide through the insulating sleeve and fit into tubular contacts at the bottom of the cans when closing the circuit. The cross-head of each U-shaped conductor is attached to a wooden rod, which extends through the top of the cell or casing which incloses the switch, and is in turn attached to a metal cross-head operated by an air motor or an electric motor, as the case may be. The three phases are seen, therefore, to be broken or closed simultaneously. When the three sets of U-shaped conductors are lifted the circuit is broken under the oil at two points in each phase, or six points in each complete three-phase switch. The range of movement of the cross-head varies with the potential to be controlled; it is 12 inches in the switches in the Metropolitan station for 6,000 volts, and 17 inches in the switches for the Manhattan station for 12,000 volts. The brass cans are lined internally with fiber to prevent the arc from jumping from the rod to the metal of the can when it is drawn up through the oil. Each switch unit stands alone on its own foundation, with the three phases in three separate cells or spaces separated by brick walls. These brick partitions act as barriers and prevent any possible burn-out in one cell from spreading to the others. As an opening of two legs breaks a three-phase line, an arc in one cell will not incapacitate the switch. The circuit-breaker or switch differs radically from older forms in the separation of the phases as indicated, and also in the separation of the contacts for each phase, in two separate oil pots. This separation of the terminals of each phase gives two separate arcs, each inclosed in a space well removed from the others, so that the possibility of an arc communicating from one pole to another is obviated. It will be seen that in breaking a three-phase circuit the arc is produced in six independent oil pots. This method of construction, together with the separation of the phases in separate fireproof compartments, accounts for the unusual effectiveness of the switch in practical operation.

It was at first thought that the use of oil switches for the control of high potential circuits would possibly result in resonance effects, particularly in circuits containing considerable capacity, such as underground cables or long overhead lines. A number of experiments have been conducted, and the weight of evidence seems to be in favor of the oil switch as avoiding these effects. It is an interesting fact that under the conditions described considerable disturbance due to resonance may occur upon the closing of a circuit. This is naturally independent of the character of the switch employed; it may occur equally well with an oil, an inclosed air, or an open-air switch. Upon the rupture of the circuit, however, the results obtained from many tests indicate that open-air switches are liable to produce heavy resonance effects while the inclosed air and the oil switch are practically free from such effects. Extensive experiments to determine this point were conducted prior to the production of the switches for the Metropolitan and Manhattan stations. Very recently experiments of a more severe character have been conducted at Kalamazoo, Mich. These tests were made at from 25,000 to 40,000 volts, with from 1,200 to 1,300 kilovolt amperes of highly inductive load, the power factor being 40 to 60 per cent. The switches tested were the cylindrical oil switch, already described (Metropolitan type); an oil switch in which all the terminals were inclosed in a single tank of oil, called the tank oil switch; a switch of the expulsion air-tube type; and an open-air switch in which the terminals were simply separated long distances in free air. In making these tests an oscillograph was used to determine the time of break and other interesting effects, and a camera to photograph any particular instructive phenomena.

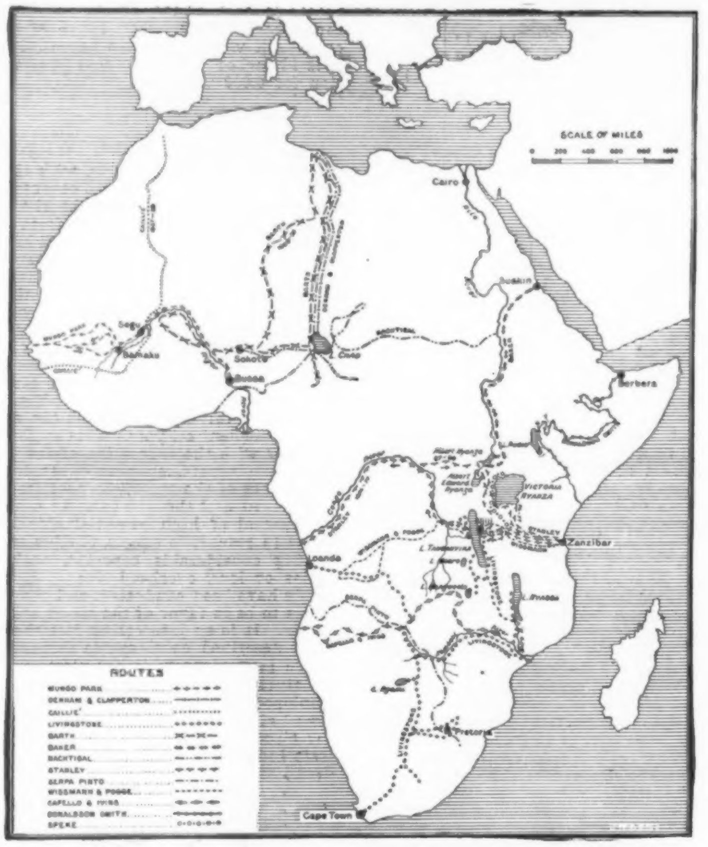
The long-break open-air switch, which operates upon the principle of drawing a long arc in the open air, opened the circuit at 25,000 volts, but required several seconds of time, and drew such a long arc as to be impracticable. At 40,000 volts the arc held and flared to a total distance of over 30 feet until it struck the line and short-circuited the system, producing at the same time high-voltage oscillations equal to two or three times the normal potential of the system. It would, therefore, seem that the open-air switch was generally unsuitable for the control of high voltage systems of large power, as even where sufficient room is available for their use the production of high resonance effects tends to endanger the system. These tests also show that wherever a short-circuiting arc occurred in the open air, electric oscillations of high voltage resulted. These were probably due to the rapid alternate extinguishment and formation of the arc during its period of interruption, the arc acting somewhat in the manner of a Wehnelt interrupting device. The expulsion-tube air switch operated up to 25,000 volts, but failed at 40,000. The tank oil switch operated satisfactorily on 1,200 to 1,300 kilovolt amperes up to 25,000 volts, but at 40,000 volts it spat fire and occasionally emitted black smoke, thus seeming to be working at the limit of its capacity. No attempt was made to open short circuits with the tank oil switch. The cellular oil switch never failed to open 1,200 to 1,800 kilovolt amperes at any voltage up to the maximum employed—40,000; the circuit opening noiselessly and without the appearance of fire or emission of smoke at the switch. It was used as an emergency switch in all the tests to open short circuits on 25,000 to 40,000 volts. The results of these and other tests, and the continued effective operation of the cellular type switch in the Metropolitan station indicate that this type of oil switch will safely control circuits of practically unlimited power at potentials considerably above 40,000 volts, probably as high as 100,000 volts. The character of the break when operating properly was the same in all the switches except the open-air type. In opening, the arc held for a number of half waves from 6 to 18 and then broke at zero value without disturbance of the system. With the oil switches no traces of oscillation were noticed before the break, and no traces of rise of voltage. With the expulsion air switch traces of oscillation were seen for a number of half waves before the final break, and in consequence a slight voltage rise occurred.

* Abstract of a paper read before the American Institute of Electrical Engineers.—From The Electrician.

THE GEOGRAPHIC CONQUESTS OF THE NINETEENTH CENTURY.

By GILBERT H. GROSVENOR.*

IN 1800, the year that Jefferson was first elected President of the United States and Napoleon won the history-making battle of Marengo, about one-fifth of the earth's land surface was known. The physical features of the remaining four-fifths were partly supplied by imaginative mapmakers or left a blank on the charts given to the public. In 1900 approximately ten-elevenths of the earth's land surface may be described as known and only one-eleventh as unexplored.



MAP OF AFRICA, SHOWING MAIN ROUTES OF EXPLORATION.

In fact, much less than one-eleventh remains unknown, for the unknown area is so distributed in both hemispheres that nowhere except at the North and South poles are there remaining large unexplored tracts. This will be readily seen by a glance at the maps that accompany this paper.

The eighteenth century had been noted for the explorers of the seas, the nineteenth was pre-eminent in men who split open great continents and laid bare to the eyes of mankind their mountains, rivers, and lakes.

AFRICA.

One hundred years ago Africa was a gigantic black plate with a white rim which had been tolerably well traced by Vasco de Gama and other bold Portuguese adventurers of the sea. Though nearer to Europe than any of the continents, stretching as it does parallel to the south coast of Europe for 1,000 miles, the deadliness of its climate had averted the greedy eyes and hands of Spain, France, England, and Portugal, who were battling for dominions in the Americas and India thousands of miles farther away. They came to Africa for slaves to develop the new world, and that was all they sought in the Dark Continent.

To-day hundreds of sharply defined lines of light, the routes of the patient Livingstone, of grim Stanley, of Baker, Speke, and Mungo Park, like the piercing beams of a searchlight have penetrated the continent from north and south, from east and west, until there remain black patches only here and there, and these are partly lighted by the rays radiating from the main lines of exploration. Every square mile of this great continent, excepting Morocco and Abyssinia, has, moreover, been peacefully parceled out within the nineteenth century to the powers of Europe, while the possession of India and the Americas cost thousands and tens of thousands of lives lost in battle.

The history of the exploration of Africa centers in the discovery of the sources of the four great rivers of the continent, the Niger, the Zambesi, the Nile, and the Kongo.

In a mighty torrent they swept into the Atlantic and Indian Oceans on the west and east and into the Mediterranean on the north, but of the four, the Nile only was known for any considerable distance. Bruce, in the last half of the eighteenth century, had penetrated from the Red Sea to the head-waters of the Blue Nile in Abyssinia and had followed the latter to its junction with the Nile near Berber, and then down the Nile to Cairo; but he had not solved the secret of that everflowing stream whose waters had for thousands and thousands of years made the valley of Egypt the granary and garden of the world.

To-day the Nile has been scientifically explored for its entire length of 3,400 miles; the Niger, with the exception of a small portion of its middle course, for 2,600 miles; the Zambesia, for 1,500 miles; and the Kongo, which in volume is exceeded only by the Amazon, for nearly 3,000 miles.

The course of the Niger was determined early in the nineteenth century and is the record of one man's work and life. Mungo Park, a Scottish surgeon, then but 24 years of age, but already well known for his discovery of several new fishes in Sumatra, in 1795 undertook to determine for the African Association of London the course of the Niger. Starting from Gambia in December he reached Segu on the Niger in the summer of 1796, and succeeded in ascending it for several hundred miles as far as Bamaku. Ten years later, 1805, he returned to Bamaku, resolved this time to follow the river which he had been the first to reach, till it entered the sea. For nearly 2,000 miles he hugged its bank in a canoe with four companions and had all but reached its outlet, when his canoe was upset in an attack by the natives at Bussa and he was drowned.

During nearly fifty years after the death of Mungo Park, exploration in Africa was confined to the Great Sahara Desert. Denham and Clapperton in 1822-24 pushed southward from Fezzan through the burning sands and discovered Lake Tchad, then to Bornu, and thence to Sokoto on the Niger. Several years later Clapperton ascended the Niger from its mouth to Sokoto, where he died.

Another crossing of the desert was made by a brilliant young Frenchman, Caillié, who succeeded in reaching Timbuktu, the mysterious African capital, in 1828. Nearly thirty years later Barth connected the routes of Caillié and Denham, and in 1867-74 Nachtigal proceeded from the Niger to Lake Tchad, then eastward through Wadai and Darfur to Egyptian Sudan. Binger, Foureau and Lamy, and numerous

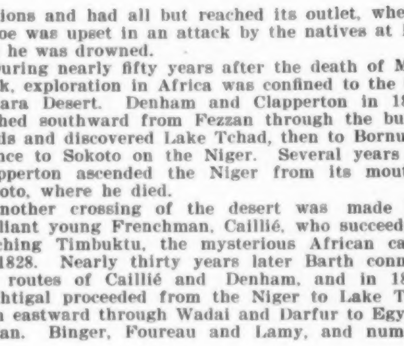


FIG. 1.—AFRICA AS KNOWN IN 1800.

The darkened portions in this and succeeding maps show the unexplored areas.

explorers of later years, have done important work in erasing the blanks between the routes of these great pioneers, while Rohlfs, farther north, explored southern Algeria, Fezzan, and the edge of the Libyan Desert.

The patient, persevering work of Livingstone made possible the opening up of the southern half of the continent. For thirty-three years he toiled in the fearful heat of the tropics, pausing only for two brief visits to England. Often he was without money and encouragement, dependent upon his scanty means and unfailing courage for the fulfillment of his broad plans. His genius laid the foundations upon which Stanley and the explorers who followed him have worked.

Livingstone had come to Africa in 1840 as a medical missionary. For nine years he had been penetrating farther and farther from Cape Colony until in 1849 he was stationed at Bolobeng, 80 miles north of Mafeking and 1,100 from Cape Colony. The chief of the people among whom he was laboring told him of a lake to the north beyond the Kalahari Desert and of a powerful chief who ruled over many tribes. Livingstone, animated with the sole purpose of extending his religion, determined to search for the chief and the lake.

On June 1 he set out, and after two months reached Lake Ngami which he found set in the midst of a luxurious, densely populated country. He was not able, however, to advance farther and thus returned to his station without seeing the chief.

Two years later he renewed his effort, passed Lake Ngami, and finally reached the Upper Zambesi at a place called Sesheke, over 1,000 miles from its outlet. Livingstone was a Scotsman and had never seen a real river before, and we can imagine what an effect this mighty stream, discovered 1,000 miles from the coast, and whose origin or outlet he knew not, must have had upon him.

He was now 750 miles from his mission post, and through the entire march he had been continually discovering lakes, rivers, and largely populated towns whose existence had previously been unsuspected. It came upon him that his true mission was to open up Africa, and he therefore returned to the Cape to prepare himself for the work.

In the summer of 1852 he retraced his route to the Upper Zambesi and followed its basin westward for some distance and then pushed farther west until he finally reached the Atlantic Ocean at St. Paul de Loanda. He then returned to the basin of the Zambesi. In all his travels Livingstone never named any lake, river, or mountain that he discovered, but he had not descended the Zambesi many miles before he came upon a grand fall whose waters were dashed upon the rocks 300 feet below. A loyal subject, he named the falls after his Queen, "Victoria." He finally reached the Indian Ocean at Quilimane, thus being the first white man to cross the continent.

In 1858 he began his second great exploration, which resulted in tracing the course of the Shire River, a tributary of the Zambesi, and the discovery of Lakes Nyassa and Shira, feed lakes of the Zambesi.

The problems of the Niger and Zambesi had thus been solved, but the Nile and Kongo still remained a mystery. In 1859 Captains Burton and Speke started from Zanzibar to discover a lake of which rumors had for a long time been heard, and in a few months succeeded in reaching Lake Tanganyika. Returning to the coast they separated, Burton taking a southerly route and Speke a more northerly one. Speke beheld in the far distance another great lake, the Victoria Nyanza, and in 1861 returned with Grant to explore it. On circling the lake they found a large river leading to the north, which they followed for some distance, when they came upon Baker (afterward Sir Samuel), who had been following it, the White Nile, from Khartum. Baker later continued his search westward and discovered a smaller lake which he called "Albert Nyanza." Thus, by the discovery of Victoria Nyanza and Albert Nyanza the feed lakes of the Nile were definitely determined.

In 1865 Livingstone set out for the region of Lake Tanganyika and discovered Lakes Moero and Bangweolo, and explored the Luapula River, which flows from Lake Moero and is the main head stream of the Kongo, though he did not know it, but probably suspected it.

The world became alarmed at not hearing from him for some time, and Stanley was dispatched to find him by James Gordon Bennett, of The New York Herald.

Stanley cut across from Zanzibar and found him at Ujiji, on Lake Tanganyika. He had been surrounded by Arab slavers, his supplies destroyed, and his communication with the seacoast interrupted. After being

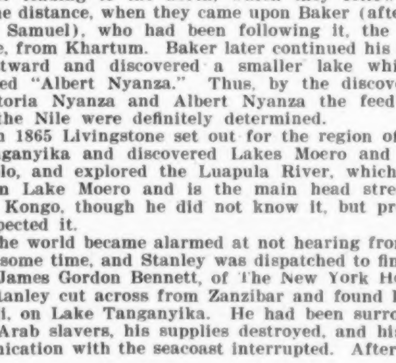


FIG. 2.—AFRICA AS KNOWN IN 1900.

relieved by Stanley, Livingstone returned to Lake Bangweolo, where he died in 1873. His faithful followers bore his body to the seacoast and later it was carried to England and buried in Westminster Abbey.

Stanley took up the work of Livingstone. After circling Victoria Nyanza, he explored Albert Nyanza and Tanganyika and discovered Albert Edward Nyanza. He then descended the Lualaba Basin, which brought him to the Kongo, which he followed to the ocean.

Stanley was thus able to solve the last great African problem, namely, that Tanganyika and the waters

* From the Annual Report of the Smithsonian Institution for 1900.

west of it belonged to the basin of the Kongo and not to the Nile.

But of more practical value than the determination of the question of the head waters of this river was the opening up to the commerce of the world of the densely populated countries along the banks of the Kongo and its tributaries.

In 1887 Stanley started to cross Africa again, this time from west to east, to relieve Emin Pasha. After leaving the Kongo he forced his way through a vast, almost impenetrable forest, and saw the pigmies, discovered by Du Chaillu twenty-five years before, and the Mountains of the Moon.

In this brief summary it is possible to mention only a few of the dauntless explorers who before and since the time of Livingstone and Stanley have helped to render obsolete the term of "Dark Continent"—the imaginative Du Chaillu, the botanist Schweinfurt; the gallant Cameron, who was the first to cross Africa from east to west (1873-75); Serpa Pinto, the Portuguese political explorer; Wissmann, who discovered the left affluents of the Kongo, and Donaldson Smith, who traced Lake Rudolf in 1894-95 and in 1900 crossed the country between that lake and the Nile, the last inhabited area of importance that was unexplored.

The feat of young Grogan, who traversed the continent from the Cape to Cairo, during the greater part of the way without a white companion, was a fitting conclusion to African exploration of the nineteenth century.

THE ARCTICS.

Three long-sought ambitions inspired the efforts of the Arctic explorers of the nineteenth century—first,

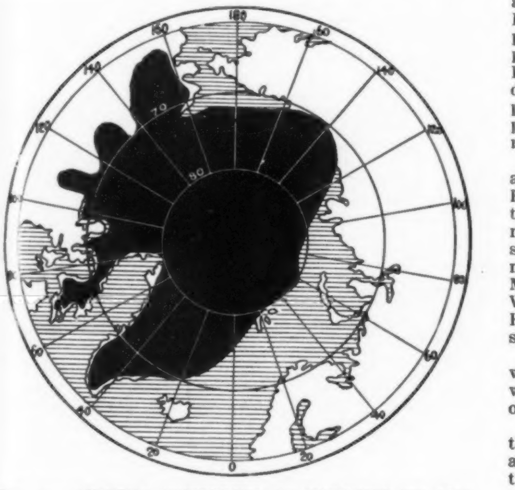


FIG. 3.—ARCTIC REGIONS AS KNOWN IN 1800.

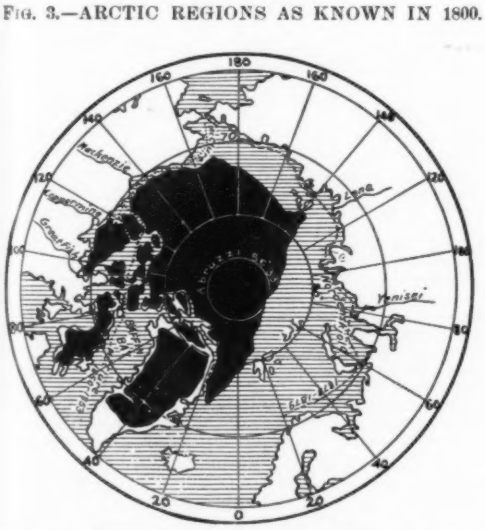


FIG. 4.—ARCTIC REGIONS AS KNOWN IN 1900.

to discover a Northwest Passage to India; second, to discover a Northeast Passage, and, third, to reach the North Pole.

The first two objects were attained. McClure, in 1850-53, forced a painful passage from Bering Strait to Europe, and nearly thirty years later Baron Nordenskjold, the Swedish scientist, succeeded in reaching the Pacific Ocean by following the Asiatic coast. Neither of these routes has yet proved of practical value to the world. With the development, however, of northern Siberia, in view of the possibility of the route being kept open by vessels of the type of the ice-breaking "Yermak," the Northeast Passage may become a route of some traffic in lumber, furs, etc.

The North Pole remains still unconquered, though it is not so remote. Hall, Lockwood, Nansen, and Abruzzi have each gone farther than his predecessor, until only 3 deg. and 27 min. have to be overcome.

In 1800 the Arctic coast of North America was undetermined. Mackenzie, in 1789, had descended to the mouth of the river which bears his name, and some years before him, in 1771, Hearne had descended the Coppermine to its mouth. Both reported an open sea to the north. On the Asiatic coast, the outlets of the Lena, Yenisei, and Obi were known, the Bear Islands had been visited, and Nova Zembla discovered centuries before.

Parry, Beechey, Franklin, and Richardson, during the earlier years of the century, helped to define the North American coast, and Scoresby outlined the east coast of Greenland. James Ross, in 1830, definitely located the North Magnetic Pole at Cape Adelaide, in Boothia Felix, and three years later Back discovered the Great Fish River.

Of the many tragedies in the annals of Arctic history none is more terrible and heartrending than that of Sir John Franklin and his crew of one hundred and twenty-nine. The "Erebus" and the "Terror," returned from the Antarctics, where they had carried Sir James Ross to splendid achievements, were placed at the disposal of Franklin, who had been knighted for his gallant work in the Arctic regions in his earlier years. He set out in May, 1845, and was last spoken by a whaler while he was waiting for the ice to open sufficiently to enter Lancaster Strait. The following year and the year after, his vessels were beset by the ice near King William Land. Franklin died in June, 1847. The crew had provisions only for one year longer, and as the vessels were still icebound the one hundred and five survivors left their ships in a desperate and vain attempt to fight their way over the ice to Great Fish River. During 1848 and for many succeeding years expeditions were dispatched both by land and sea from the east, west, and south to search for the missing men, but it was not until 1854 that Rae met a young Eskimo who told him that four years previously forty white man had been seen dragging a boat to the south on the west shore of King William Land, and a few months later he had found the bodies of thirty of these men.

McClure and Collinson were sent out in 1850 to attempt the search from the west through Bering Strait. McClure started without waiting for Collinson. He gradually worked his way eastward, winding back and forth through inlets and around headlands and islands, many of which he was the first to discover, and at last emerged through McClure's Strait into Barrow Strait. Finally, in Baffin's Bay, he was compelled to abandon his ship, the "Investigator," and push on over the ice. Fortunately he was met by a Franklin search expedition coming from the east under Sir Edward Belcher. By this feat, the first completion of the Northwest Passage, McClure gained the prize of $50,000 that had been offered by Parliament ninety-two years before.

Nine years of unceasing effort had failed to find any record of Franklin's terrible fate. But Lady Franklin was still undaunted. In 1857 she equipped the steam yacht "Fox" and sent it to the Arctics, commanded by McClintock, the most untiring master of sledge work. Eight hundred miles of coast line were minutely examined. In the early summer of 1859 McClintock stumbled upon a human skeleton in King William Land, and about the same time his companion, Hobson, found a record of the Franklin expedition, stating briefly its history between 1845 and 1848.

The result of the many Franklin search expeditions was the mapping more or less accurately of the network of islands extending along the northern coast of North America.

Meanwhile Kane, Hall, and Nares were completing the surveys of Smith Sound, Grinnell Land, and the adjacent shores of Greenland. The Greely expedition proved that to the north of Greenland was an open channel and gained what is still most northerly land, 83 deg. 24 min. Later Peary followed this channel in his brilliant crossing of North Greenland, and proved conclusively that Greenland was an island.

Nordenskjold had already spent twenty years adding to the maps of Greenland, Spitzbergen, and the Kara Sea, when, in 1878, he determined to reach Bering Strait by crawling around the headlands and islands of Northern Asia. Without any hindrance he had arrived almost in sight of Bering Strait when the tantalizing ice closed in before him and for ten months his ship was held motionless. Then the ice mass deigned to part and allow the "Vega" to sail the few remaining miles to and through the strait, and thus complete the Northeast Passage.

Franz Josef Land, which has lately been a favorite base in the "dash for the pole," was discovered and explored by Payer and Weyprecht in 1872-73; later Jackson, 1895-96; Baldwin, 1899; and Abruzzi, 1900, have extended our knowledge of this region and shown that beyond the islands is an ice-covered sea.

In the early nineties Dr. Nansen originated a new method of attack of the North Pole, "the drift theory." His experiment of allowing his ship, which was specially constructed to elude rather than to resist ice pressure, to be carried at the will of the ice floes, proved very successful, and he gained latitude 86 deg. 14 min., which was only eclipsed by Abruzzi in 1900.

ANTARCTICS.

Around the South Pole there hangs an unexplored mass twice the size of Europe. It may be a vast continent or an Antarctic ocean; the problem is yet unsolved.

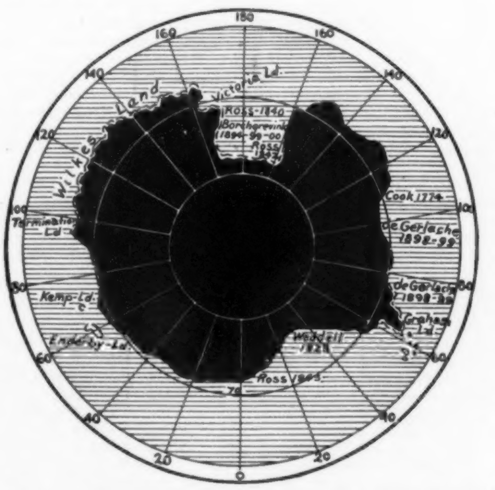


FIG. 5.—ANTARCTIC REGIONS AS KNOWN IN 1900.

The names that shine brightly in the history of South Polar work during the century began with Captain Smith, who discovered the South Shetland Islands in 1816. Weddell, several years later, found an active volcano on these islands and reached as far south as 74 deg., but discovered there no land. Enderby Land and Graham Land were seen first by Biscoe in 1832. Wilkes in 1840 discovered the land named after him, and Sir James Ross, of previous Arctic fame, about the same time discovered Victoria Land, and upon it beheld two active volcanoes pouring forth flaming lava amid the snow, and named them Erebus and Terror, after his two ships. In January, 1842, he reached farthest south—78 deg.—a record that was not eclipsed until 1899, when Borchgrevink reached 78 deg. 50 min. by sledge.

No white men had ever passed the winter within the Antarctic Circle until De Gerlache and his crew in 1898 wintered on board their ship, the "Belgica," which they had banked with snow. The following winter Borchgrevink with his crew lived on the Antarctic ice.

The closing year of the nineteenth century witnessed the near completion of two well-equipped expeditions that are to set out in the summer of 1901 for South Polar regions—one equipped by Germany and the other by Great Britain. Both are led by competent and daring men, and great additions to our knowledge of the Antarctics may be justly expected.

AUSTRALIA.

The last months of the nineteenth century beheld the beginning of a new power in the South Pacific.

FIG. 6.—AUSTRALIA AS KNOWN IN 1800.

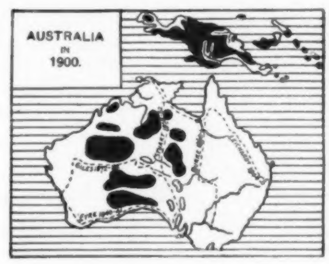


FIG. 7.—AUSTRALIA AS KNOWN IN 1900.

Six millions of Englishmen, in a land as vast as the United States, united to form a new nation, which the twentieth century was to inaugurate. The first year of the nineteenth century found Australia inhabited by degenerate savages, with a handful of English settlers scattered along the coast of what is now called New South Wales. The coast line of Eastern Australia had been definitely traced and enough facts of the north and west coasts ascertained for a rough outline of their extent, but the south coast was undetermined and absolutely nothing was known of the interior. Port Phillip, the magnificent harbor on which gaze the half a million inhabitants of Melbourne, the wealthiest city in the Southern Hemisphere, had been entered by no European ship. The immense lifeless mass had no name of its own, but appeared on the maps as New Holland.

Capt. King early in the century investigated the river mouths and completed the shore line for the west, northwest, and north coast. Sturt in 1828 and succeeding years explored New South Wales and penetrated to the center of the continent. Eyre in 1840 traced the south coast along the Great Australian Bight. The first crossing of the continent was made by Stuart in 1862. He passed through the center of Australia and planned the route which the transcontinental telegraph now follows. Col. Warburton in 1873-74, starting from the central point of the telegraph line, succeeded in reaching the west coast, and later Giles and Forest explored the country to the southwest. Leichardt successfully crossed Australia diagonally from Port Essington to Moreton Bay, but on his second expedition, in 1848, he mysteriously disappeared in the sandy deserts of the northeast and numerous search parties have failed to find any trace of him.

Overland routes have now been found possible between all the widely separated colonies, though they are scarcely convenient for traffic. The explorations of more recent years have shown that wide areas of splendid grazing land surround the deserts.

NORTH AMERICA.

Of the geographical conquests of the nineteenth century the most marvelous has been the conquest of North America, more particularly of the western United States. It has been the work not so much of the geographer or explorer, as of the colonist and the miner, made possible by Yankee inventions that economize space, time, and money.

In 1801 the continent west of the Mississippi was unknown, the existence of the Rocky Mountains unsuspected. The atlases of the time describe North America as "chiefly composed of gentle ascents or level plains." They knew of "no considerable mountains except those toward the Pole and that long ridge which runs through the American State and is called

the Appalachian or Alleghany Mountains." Immediately after the Louisiana Purchase Lewis and Clarke were dispatched to the new land to explore it, and they made their historic march up the valley of the Missouri River, across the Rocky Mountains, and down the Columbia to the sea. Pike, the year following, commenced his explorations of the country between the Mississippi and the Red River and discovered Pike's Peak in 1806. Bonneville, in 1831-38, explored sections of the Rocky Mountains and California. Fremont, the most noted of American pioneers in the West, in 1842 explored the South Pass of the Rocky Mountains and in the following years the

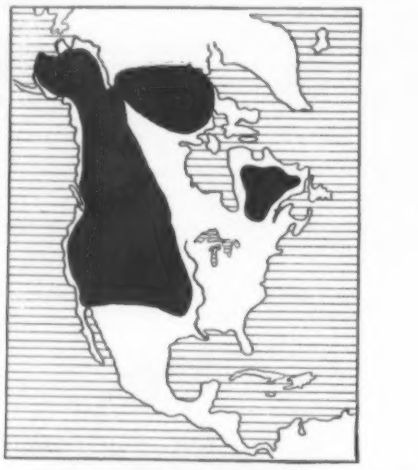


FIG. 8.—NORTH AMERICA AS KNOWN IN 1800.

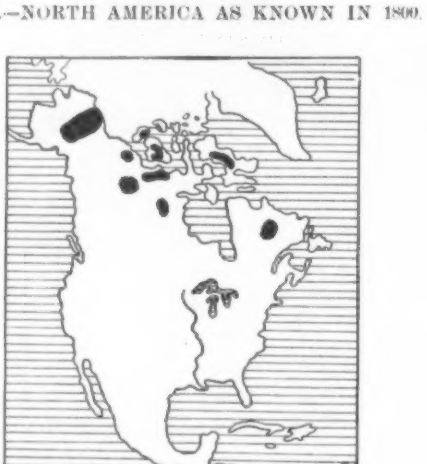


FIG. 9.—NORTH AMERICA AS KNOWN IN 1900.

Pacific slope. Powell, in 1869, traversed the noble and menacing gorges of the Grand Cañon of the Colorado. Meanwhile Whitney, Wheeler, and Hayden were investigating the mountain systems of the West.

In Alaska, Dall was the pioneer and his work revealed the extent of the Yukon. Kotzebue, the Russian navigator, fifty years before, in 1816, had coasted along the northwest coast of Alaska and discovered the magnificent sound which now bears his name. Schwatka, Allen, Abercrombie, Brooks, and Schrader, and others, including gold prospectors, have explored the territory very rapidly until only a few tracts remain unknown. In Canada, Dawson and Ogilvie have worked in the Yukon watershed; Bell and the Tyrrell brothers around Hudson Bay, and Low in Labrador.

SOUTH AMERICA.

Of the six continents South America is now the least known, though one hundred years ago it was better

FIG. 10.—SOUTH AMERICA AS KNOWN IN 1900

explored than any continent except Europe. The Jesuits had penetrated to the heart of the continent on the rivers which radiate in all directions and had been able to publish tolerably good maps. But the continual state of unrest and the depleted treasuries of the South American governments, with the lack of the incentive of trade and colonization, have kept them from keeping pace with the geographic advance in other sections of the world.

Humboldt, in 1799-1804, traveled in the basins of the Orinoco and Magdalena and in various sections of the Andes. He was the first to interpret the word "geography" in its original, truest, and broadest sense, i. e., "description of the earth," which includes meteorology, climatology, the distribution of animals and plants, and the nature of soils, as well as the mere mapping of rivers and mountains. Later his interpretation of the work of the geographer and explorer was accepted by all the scientific explorers of the nineteenth century. Later, Spix and Martius botanized in Brazil, Schomburgk explored British Guiana, Crevaux and Chandless investigated the mighty tributaries of the Amazon, Castelnau explored the Paraguay, and Hatcher, in 1898, made important discoveries in Patagonia.

ASIA.

Marco Polo was the only European who before 1800 had traversed any considerable part of Asia. But during the nineteenth century the continent was overrun by explorers of every nationality, who have made the map of the continent in the larger details quite accurate. Russia from the northeast sent numberless explorers, and England vied with her from the south. In one respect, perhaps, the geographic conquest of Asia has been more remarkable than that of Africa, Australia, or North America, for to penetrate this giant continent the explorer has had to contend against

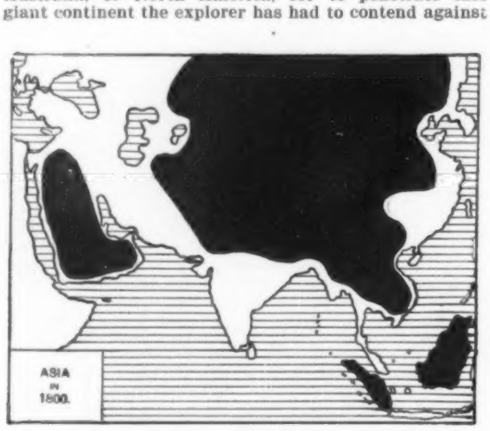


FIG. 11.—ASIA AS KNOWN IN 1800.

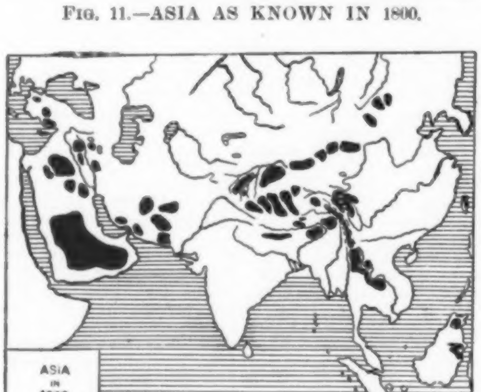


FIG. 12.—ASIA AS KNOWN IN 1900.

hundreds of millions of people—all prejudiced against his advance and of quite a different character from the naked savages of the "Dark Continent."

Humboldt, in 1829, invaded Central Asia and the country of the Caspian Sea. The French missionary, Huc, succeeded in traversing Tibet in 1844-45, and lived several months at Lhasa. Palgrave, in the early '60's, journeyed across Arabia. The adventurer Garnier, in 1866-68, surveyed the course of the great Mekong and traversed over 5,000 miles in Cambodia and China, almost all of which was previously unknown to European geographers. Ney Elias at the same time was ascending the mighty Yangtze and penetrating western Mongolia. Fedchenko, in Pamir, and the untiring Prejewalski, in Mongolia and western China, were rapidly mapping these regions. Prejewalski made four separate journeys to western China, and in the importance and extent of his explorations in the heart of the vast continent has been equaled by none except Sven Hedin. Richthofen and Pumpelly in China, Rockhill in Tibet, Forsyth in East Turkestan, and the faithful, plodding pundits of the trigonometrical survey of India north of the Himalayas, are a few of the many men who have contributed much to the progress of geographic knowledge of Asia.

CONCLUSION.

The progress of geography during the nineteenth century has thus opened to the white man almost every corner in the immense, diverse world of which he is a part. But the even more startling advance in geographic sciences, or, more truly, the creation of these sciences during the century, has nearly explained the manner of origin and the formation of the world itself. Geology, which describes the nature and forming of the earth's crust, tells of glacial action, and by means of fossils proves that the earth millions and millions of years ago was covered with life; meteorology, which studies the conditions governing the heavy and yet light mantle of the earth; oceanography, which is beginning to explore the lands beneath the oceans, are all geographic conquests of the nineteenth century. The "Dark Continent" at the beginning of the twentieth century is that immense land surface buried beneath the oceans, an area thrice the area of the exposed land surface. Maury and Murray and the soundings for submarine cables have but scratched the surface as with a pin. To solve the many mysteries which the oceans hide is the problem of the explorer of the twentieth century.

DR. SVEN HEDIN IN CENTRAL ASIA.

THE following is the first of two letters recently received, addressed by Dr. Sven Hedin to his Majesty the King of Sweden and Norway, and is from The Evening Post:

Temirlik, in Chimen Tag, South of Lob Nor, October 30, 1900.—The journey of last summer has been brought to a successful termination, and I think I may truly say that it is extraordinarily rich in discoveries and scientific observations, as well as in adventure, and that it will be the crowning effort of the expedition.

In the mountainous tracts of Chimen I made a depot, and there left the greater part of the caravan, under the command of the Cossack Schagdur, and of Islam Bai; myself striking camp with a lighter caravan on July 30, for the purpose of exploring the unknown regions in the table-lands of northern Tibet. After a "circular tour" of ninety-three days, we arrived back at the camp, having covered 965 miles, or a distance, as the crow flies, as great as from Paris to Stockholm. This long excursion was through entirely unknown country, and I mapped it to the very smallest detail in 173 maps.

My caravan reckoned at the start six servants (among them the Cossack Tjerden), seven fine camels, twelve horses, one mule, and, in the capacity of living provisions, sixteen sheep. Of this party there returned only five men, four camels, three horses, and the one mule; the greater number of the animals having died from privation and fatigue, while most of the sheep were eaten by wolves. After that, in order to get fresh meat, we were reduced to hunting, and were very successful in our efforts, as we shot as many yaks, khulans (wild asses), and orongo-antelopes as we required for consumption.

A great sorrow was the loss of my Afghan yak-hunter. He was ill for a fortnight, and it was no easy matter to convey a dying man with us in such country as we were then traveling through. The caravan animals gave in one by one, partly on account of the poor and insufficient pasture, and partly from the rarification of the air, for we were the whole time more than fifteen thousand feet above the sea level, and as a rule had half the atmosphere below us.

Our route first led to the south, across the mountain-chains of Chimen Tag, Ara Tag, and Kalta-alagan to Lake Kum-Kul, where for the first time we shot some khulans, capturing their foals alive. We proceeded thence across the Akka Tag, the largest mountain-system in the world, and proved it to consist here of four parallel chains. To the southward of them we found ourselves in the Tibetan plateau proper, an immense protuberance from the earth's surface with parallel chains of mountains running from it in directions east and west. Between these extend valleys abounding in large lakes which are generally salt. We passed King Oscar Mountain, at a distance of only a few miles, and continued our way southward to latitude 34 deg. 21 min. north, not far from the sources of the Yang-tse Kiang, but as the caravan was beginning to give in I deemed it wiser to turn back from here. On the return journey we traveled westward, northward, and eastward, until in due course we reached Tenirlik.

This journey, so successfully ended, has been the means of enabling me to fill in a white patch of considerable magnitude on the map of Tibet. True it is that one does not meet here dangers such as one might expect in a hostile country, but all the same there is many an enemy following the caravan like a dark shadow and lying in wait to destroy it. And in a measure, too—to the extent of half the caravan—they were successful. Out of twenty only eight animals returned, and those were totally worn out and will require a long time in which to recover.

WIND AND HAIL.

One of the worst enemies that we had to contend against was the west wind; daily we suffered from its continuance and sorely it tried our patience, for it was generally laden with hail and snow. In these regions, which are as high as seventeen Eiffel towers placed one on the top of the other, you are nearly frozen every day's march, and it is difficult to warm yourself by walking, for you are generally at the point of falling from want of breath. The minimum temperature was as low as 4 deg. below zero Fahr.

I took with me a small English canvas boat, but it proved to be a dangerous craft on Tibetan lakes. You start forth on a fine morning and are probably overtaken, as I was on three of the lakes, by a hailstorm. A situation of the kind is a difficult one to meet, and as the squalls come on without any warning whatever, the only thing to do is to let the boat drift at its pleasure, balancing it as best you may with the oars and movements of the body. The most disagreeable part of these squalls was that it became quite dark, so that we could not see more than a couple of yards in front of us for the hail; the big stones filled the bottom of the boat, and the waves increased to the size of small tents. I always had with me on these voyages a first-rate rower from Lob.

It was a grand sight to see all the different kinds of wild animals: the yaks grazing quietly in the valleys or licking with their jagged tongues the moss and lichen from stones and crannies where our animals would not find a blade of anything that they could eat. The khulans circled in almost military order round our caravan, and the antelope fled from us in herds, often of several hundred head. Then there were wild sheep (Ovis Poli), wild goats, hares, and other rodents, bears (we shot one fine beast), wolves, and foxes. On the other hand, we did not see a single trace of man for eighty-four days, though an old drawing sketched roughly on a wall of rock proved that Mongolians once inhabited these tracts; or possi-

bly it may be a place where they were in the habit of stopping on their pilgrimages to Lhasa.

I found all well at our large camp on my return here, and have now rested several days, and to-morrow, when the express messenger shall have started, I mean to begin to develop some photographs. At the beginning of November I start on a trip to the mountains in this neighborhood, and they are already covered from foot to crown with snow. Then will follow a three months' journey through the plains of the northeast to Sa-chu, and afterward westward to the desert of Lob, where, during the course of the winter, I intend to make further investigations, and anticipate much interest from them on account of the remarkable discoveries I made there in the spring. At the beginning of March I mean to go to the little town of Charklik, to the west of Abdal, where half the caravan will winter under the command of a Cossack, and where for the last time during this journey I shall be able to send your Majesty, as I hope, important news from the very inmost parts of Asia. SVEN HEDIN.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Trade With France.—The following paragraphs are taken from the annual report of Consul-General Skinner, of Marseilles:

Wheat and Semolina.—No complaint has reached me during the last year concerning the accuracy of American inspection certificates. I regret that I have not always been able to say as much in previous reports. The fact that American exporters of grain and other staple products are able to make sales based upon inspection certificates issued under the auspices of various boards of trade is the highest compliment possible to the commercial honesty of our business men, and constitutes an asset of incalculable value, which should be surrounded by every safeguard possible. American certificates have been accepted in the past to a considerable extent because of unsatisfactory deliveries of grain from other competing nations. The situation elsewhere is improving—very notably in Argentina. Where grain was formerly shipped in open cars and permitted to stand out in all sorts of weather, and then forwarded to destination without any preliminary cleaning whatever, it is now in many instances selected for shipment with every reasonable precaution, sent in box cars, and delivered in good condition. The point which I wish to make prominent is this: Although at present our certificates have value because our exporters understand the wisdom of fair dealing, they are not issued in such a manner as to give the foreign buyer any legal guaranty. We have established recently a Bureau of Weights and Standards, and it occurs to me that this bureau, in connection with the Department of Agriculture, might devise some system of establishing cereal standards at the commencement of every crop year, to be made the basis of inspection certificates. There is to-day no grain standard which the commercial organizations of our country are prepared to accept as absolute, and as long as this condition exists, acrimonious disputes are certain to arise.

This year France again enters the list of wheat-importing nations to an important extent. It is estimated that there will be a shortage of 56,000,000 bushels, and that the United States may reasonably expect to supply through the port of Marseilles about 20,000,000 bushels. In the last ten years, the best wheat crop recorded in this country amounted to 9,945,989 tons. This was in 1899; last year's crop amounted to 8,455,016 tons, and this year's is expected to be materially less. The imports at Marseilles during 1900 amounted to 567,618 tons, of which the United States supplied only 10,543 tons. In normal years it should be understood that the imports at this city consist almost exclusively of very hard macaroni wheats, received from Algeria, Tunis, and Russia. The fact that these wheats have not hitherto been grown in the United States has aroused a great deal of interest in our country, and both the consular officers and explorers of the Agricultural Department have been very active during the past year in securing information and seed, with the result of a fair prospect that at least 100,000 bushels of true macaroni wheat will be included in the American harvest of 1901. It is hoped that within a very few years our exporters will be in a position to place in this market a fair proportion of the many millions of bushels annually required for the manufacture of semolina, which is produced in greater quantities in Marseilles than anywhere else in the world. The exportations from Marseilles of semolina alone amounted in 1900 to 37,001 tons, and in 1897 to 64,603 tons. The sole reason for the apparent decrease in the volume of business is the inability of the manufacturers to get the proper kind of wheat. The demand for macaroni and the other products of semolina, which is distinguished from flour by its granulated appearance, has grown by leaps and bounds throughout Europe, and the manufacturers, finding great difficulty in securing the necessary hard wheat, have been obliged to use the so-called "Metadiné" wheats of France, which are half hard and are grown from hard seed. The exportations of edible pastes from Marseilles amounted to 4,914 tons in 1900, and the value of the macaroni and vermicelli exported to the United States during the year 1900 from France, Italy, Spain, and Austria was $749,-182.

In a report of this character, I can only briefly supply a few of the more telling facts relating to this industry, which at the present time is of insignificant proportions in the United States. It is felt by all who have investigated the question, that the American people have had no opportunity to understand the value of macaroni as a staple article of food, and that future years will develop the American demand, assuring to our farmers the sale at home of all the hard wheat they can produce, without considering the possibilities of entering the European markets.

Metric System.—An incident occurred during the year which is worth noting, as illustrating the desirability of the adoption of the metric system in the United States, which, except Great Britain, is the only important manufacturing nation still employing the old system. In August of last year, the United States naval collier "Scindia" arrived at this port, with boiler tubes burnt out, and under urgent orders to proceed to Manila. The ship came to Marseilles, as it was considered, and in fact was, the port best equipped to make the absolutely essential repairs. Every facility was offered for the prompt refitting of the boilers by local contractors, but it was found that all the tubing in the city had been manufactured in France, and according to metric dimensions, and none of it could be utilized in the "Scindia's" boilers without forcing the shells. There was the variation of a hair's breadth in the dimensions, but it was sufficient to prevent the work from being accomplished, and orders had to be cabled to the United States for material, which was brought over on one of the German steamers—probably at express rates—and delivered at Naples, where the repairs were eventually carried out. The ship was delayed two or three weeks, in consequence of the fact that her boilers had been built upon a scale of feet and inches, while European tubing was manufactured according to the metric system.

Hail Cannon in Switzerland.—Considerable interest is being manifested here in the action taken by the Swiss government, looking toward the erection of bombarding stations in certain parts of the country for the prevention of the destructive hailstorms which at times have devastated entire districts.

The government in the first instance appointed Colonel Stahel and Mr. Girsberger to proceed to Italy and Styria, to study the question and see what results had been achieved in these countries, where bombarding stations have for some time been in operation. These gentlemen have made a long and detailed report to the government, recommending the adoption of one of the systems in practice, and from the report the following has been extracted:

"It is only within the last year that hail guns and protection against hail by cannonading the dangerous clouds have become a topic of general discussion. To-day the question is one of the greatest and most intense interest for all who are in any way connected with agriculture and horticulture, and for the governments which have to protect these most important branches of human industry, especially in those countries which are more than others exposed to hailstorms.

"The classical land of hail shooting is Styria. The vine growers there suffered so frequently and disastrously from hailstorms that they were forced to devise all sorts of means of protection; wires were stretched over the vineyards, and when danger was anticipated, these were covered with cloth, planks, etc.—wearisome work, indeed. Ordinary small mortar guns were occasionally fired against the clouds in order to dispel them. Burgomaster Stieger, of Windisch-Feistritz, in Styria, took up the matter in a thorough and successful way and is to-day acknowledged by all those interested in hail shooting to be the originator and master of shooting as a means of protection against hailstorms.

"From Styria, hail shooting spread over Hungary and northern Italy, where at the present time more than ten thousand shooting stations are established. It appears that warm, marshy countries with broad rivers show the greatest interest in the means of protection against hailstorms, which may lead to the conclusion that such countries are more than others subject to hail. This, again, confirms the experience that warm layers of air saturated with moisture, rising from damp, low countries, will turn into dangerous hail clouds when they meet a cold air current in the higher regions of atmosphere.

"A well-regulated shooting station consists of a little house of about 4½ by 9 feet square, divided into two rooms, of which the smaller one contains the gun and the larger one serves as a loading room. The principal part of the gun is a vertical mortar 8 to 11 inches long, with a caliber of about 1½ inches. To the mortar is attached a conical funnel of a length of 7½ to 12 feet, the upper part of which projects from the top of the house. The supply of gunpowder ought to be kept well sealed in tins, divided into charges of 80 to 160 grammes, and there should be a sufficient quantity for fifty shots for each gun.

"The stations are distributed over the danger districts, 1,200 to 1,800 feet apart. Thus, one station will protect about 62 acres. One gun more powerful than the others may serve as an alarm gun for a whole district, and ought to be in charge of a person who has some experience of the signs of an approaching hailstorm. Upon an alarm being given, all guns in the district should start firing, giving one shot each minute. Quicker firing is said to be less effective, as the shots would not have time to take full effect.

"After firing a shot, a white ring will be seen rising from the funnel, gradually increasing in size to the diameter of 9 to 12 feet. Its force is sufficient to break wood sticks on its way, and if it hits at a distance of 300 feet or more a target made of coarse hurdlework, it cuts out a ring, leaving the center and the circumference unhurt. The effect of the air ring shot into the hail clouds is not sufficiently explained, but it disturbs their natural course of dangerous development. A direct proof that hail shooting properly practised will under all circumstances prevent hail is of course impossible to furnish; but the fact that certain districts of Styria, which were before the use of hail guns devastated by hailstorms year by year, have not for the last five years, since the guns are in use, experienced any hail is a strong point in favor of the hail guns. The question is important enough to cause thorough experiments to be made, the more so as the expenses for the service of a system of hail guns will not amount to one-tenth of the insurance paid at the present time, even if the necessity of cannonading would arise every year. In order to meet with success, it is not only necessary to have good working and not too complicated guns, but also a rigid and well-organized service."

Upon this report a commission has been named which will adopt regulations for the service; and to prevent desultory private action, it has been decided to act as quickly as possible. The regulations in preparation will propose the forming of societies in all the interested districts, and the guns will be distributed so as to determine by practical demonstration which system is the most effective.—Henry H. Morgan, Consul at Aarau.

How to Win Trade in France.—I am continually receiving letters from merchants in the United States, requesting names of dealers in this consular district. I have answered hundreds of such letters with, I am sure, very little definite result.

The inquirers do not realize the obstacles to transacting business with the foreign merchants by correspondence. The difference in the money, in the measures of quantity, and the important matters of duty and freight are not taken into consideration.

The merchants of an inland city like Rheims, with no port of entry, who know nothing about custom-houses, will not take the trouble to translate English letters into French, make the calculations necessary to turn dollars and cents into francs, or English measures into French equivalents, and find out how much the freight and duty will be. It is much easier for them to buy from some distributing center in France, where there are houses equipped to do all this, which have competent salesmen who travel all over the country showing samples, and prepared to state, not the price in dollars and cents free on board in New York, but just the sum in French money the merchants would have to pay for the goods delivered at their stations.

My opinion as to the best way to win foreign trade is expressed in a letter to an association in the United States, desirous of securing a market in France for a patented article of merit. I quote extracts:

"I inclose, as you desire, the names and addresses of two large dealers in hardware, but this is what I advise:

"If you are not proposing to send competent men on your own account to canvass France, select the most capable man you can secure and have him go to large distributing centers, like Paris and Havre. There, he should interest merchants in the hardware line who have salesmen and agents all over France. You should try to have every town and village in France visited by active salesmen speaking the French language, and carrying samples of your goods."

He who would sell goods in this age of competition must do so by soliciting trade—that is to say, he must have competent agents to send directly to the buyer, or he must pay a commission to an agent who has the equipment to do so.

The merchants of the United States who have established a trade in France have accomplished it by opening general agencies at important points; and these merchants, who are doing a large business, will not sell goods except through their agents.

Selling goods directly by correspondence, thus avoiding all commissions, is plausible in theory, but does not succeed in practice.—Wm. A. Prickitt, Consul at Rheims.

Traffic of the Kaiser Wilhelm Canal.—Under date of October 18, 1901, Mr. Jackson, secretary of embassy at Berlin, transmits copies of a pamphlet on the Development of Traffic in the Kaiser Wilhelm Canal. Mr. Jackson notes that the canal dues paid by the United States steamship "Enterprise" amounted to 400 marks ($95.20) and those of the United States steamship "Buffalo" to 900 marks ($214.20), which, he adds, would apparently indicate that it is less expensive for our ships to go through the Kaiser Wilhelm Canal than to round the Danish Peninsula, taking into consideration the saving in time and coal. The total traffic of the canal in 1900, exclusive of ships of the German navy, was 29,571 ships, with a net registered tonnage of 4,292,258. The through traffic for the five years, January 1, 1896, to December 31, 1900, has more than doubled (222.22 per cent) as regards number of vessels, and almost trebled (269.99 per cent) as regards tonnage. The canal has given repeated proofs of its capabilities in regard to the number of ships passing in one day. For example, on June 15, 1900, 118 vessels, with 20,649 net registered tonnage, passed the canal, and it has likewise stood the test as regards its navigability for very large vessels, such as the German cruiser "Fürst Bismarck," and the Japanese cruiser "Yakumo;" in fact, the average size of the vessels passing the canal has risen from year to year. It has been possible to maintain the traffic without any interruption from ice, even throughout the severe winter of 1896-97, when the sound and the belt were blocked by ice.

New Electric Railway in Ontario.—Commercial Agent Hamilton, of Cornwall, November 1, 1901, reports that United States and Canadian capitalists have formed a company to build and operate an electric railway from Toronto to Cornwall, with a branch line from Brockville to Ottawa. The surveying and other preliminary work has been done, and at the next meeting of Parliament application will be made for a charter.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

A Polish Cleaning Agent is prepared by dissolving 200 grammes of soda crystals in 450 grammes of soap water, adding 35 grammes of petroleum, 30 grammes of paraffine oil, 5 grammes of spirit varnish and 125 grammes of levigated chalk and dyeing red with a tar dyestuff.—Chemiker Zeitung.

The Stretching of Leather Belts.—The Bruenner Monatsschrift fuer Textil-industrie reports on an experiment to save the belts by throwing them off during long periods of rest. Of two leather belts of equal dimensions and quality of leather for two lathes which stood alongside of each other and were equally used, one was always left on the pulley while the other was thrown off every night. While the former had subsequently to be shortened five times, the other only required to be restretched once, and was still in use when the first one had already become unserviceable.

Production of Effervescent Salts.—The production of effervescent salts of various kinds is accomplished, according to Adrian, in the following manner: Mix, for example, very finely powdered lithium carbonate 1,200.0, very finely powdered citric acid 4,800.0, sodium bicarbonate 6,000.0, very carefully and place this mixture on the water bath in a porcelain or clay dish. Soon the acid begins to melt in its water of crystallization and to decompose the bicarbonate. This reaction is assisted by thorough mixing with the hands, thus obtaining a frothy mass which is rubbed through a sieve and quickly dried at as low a temperature as possible.—Pharmaceutische Zeitung.

Method of Killing Fish in Holland.—The ordinary method of killing fish, i. e., to hurl them with their head against a hard object or to pierce their tail, under the impression that this quickly produces perfect insensibility, is an awful cruelty. In Holland a deep incision is made with a very sharp knife close behind the head of the fish, and after that several cross cuts in the back. This makes it possible to tell whether the fish were alive before this operation or dead; if the former is the case, the cutting surfaces will stand far apart. Besides, stress should be laid on the fact that by this mode of treatment a firm but delicate and exceedingly palatable meat is obtained.—Illustrirte Landwirthschafts Zeitung.

The Cement on Marble Slabs.—The whole marble slab is thoroughly warmed and laid face down upon the neatly cleaned planing bench upon which a woolen cloth is spread so as not to injure the polish of the slab. Next, apply very hot, weak glue to the slab and quickly sift hot plaster of Paris on the glue in a thin even layer, stirring the plaster rapidly into the applied glue by means of a strong spatula, so that a uniform glue-plaster coating is formed on the warm slab. Before this has time to harden tip the respective piece of furniture on the slab. The frame, likewise warmed, will adhere very firmly to the slab after two days; besides, this process has the advantage of great cleanliness.—Allgemeine Tischler Zeitung.

Time Light Cartridges.—The Photo-chemical Factory Helios at Offenbach, Germany, has placed on the market so-called "Zeitlichtpatronen," consisting of celluloid capsules filled with flashlight powder and provided with a fuse. The combustion, whose duration is determined by the size of the cartridge, is rather quiet, without a report and with little smoke. The cartridges are very useful for exposure in which artificial light is necessary; the advantage of their use lies in the possibility of varying the time of exposure, as well as in their easy management and freedom from danger. An analysis of the contents of the cartridge conducted by Fr. Novak, gave the following result: Aluminium 12 per cent, magnesium 13.5 per cent, red phosphorus 1.5 per cent and strontium nitrate 73 per cent. The combustion products consist of aluminium oxide, magnesium oxide, strontium oxide, nitrogen, nitric oxides and phosphoric acid, and show a feebly acid reaction.—Photographische Correspondenz.

Pumice-Stone Soaps.—These soaps are always produced by the cold process, either from cocoanut oil alone or in conjunction with tallow, cotton oil, bleached palm oil, etc. The oil is melted and the lye stirred in at 32 to 35 deg. C.; next the powdered pumice-stone is sifted into the soap and the latter is scented. Following are some recipes:

Cocoa-nut oil	40 kilos
Cotton oil	10 kilos
Caustic soda lye, 38 deg. Bé	24 kilos
Caustic potash lye, 30 deg. Bé	1 kilo
Powdered pumice-stone	25 kilos
Cassia oil	150 grammes
Rosemary oil	100 grammes
Lavender oil	50 grammes
Safrol	50 grammes
Clove oil	10 grammes

Cocoa-nut oil	50 kilos
Caustic soda lye, 40 deg. Bé	25 kilos
Powdered pumice-stone	50 kilos
Lavender oil	250 grammes
Caraway oil	80 grammes

Cocoa-nut oil	30 kilos
Tallow	10 kilos
Caustic soda lye, 40 deg. Bé	20 kilos
Powdered pumice-stone	10 kilos
Cassia oil	40 grammes
Bergamot oil	160 grammes
Lavender oil	20 grammes
Clove oil	20 grammes

Cocoa-nut oil	40 kilos
Soda lye, 40 deg. Bé	20 kilos
Water	7 kilos
Powdered pumice stone	20 kilos
Bergamot oil	100 grammes
Cinnamon oil	100 grammes

Bleached palm oil	30 kilos
Cocoa-nut oil	20 kilos
Caustic soda lye, 40 deg. Bé	25 kilos
Water	2 kilos
Powdered pumice-stone	50 kilos
Lavender oil	200 grammes
Geranium oil	80 grammes

—Seifensieder Zeitung, Augsburg.

EXPLORING A NEW RIVER.

Two years ago the Commercial Society of the French Congo began explorations north of the Mobangi tributary of the Congo to ascertain the resources of that part of the French colony. This region, as far north as Lake Chad, is still one of the least-known parts of Africa. Mr. Georges Séguin of this society has just ascended the Kuango tributary of the Mobangi for about three hundred miles. His boats were finally stopped by impassable rapids. His purpose was to establish commercial relations with the natives and to learn what resources may be developed.

The explorer had a large quantity of red and gilt beads and copper wire with which to pay his way. His trade goods in one detail were unique. He had a lot of common, broad-brimmed straw hats such as farmers wear, and used them in a way that contributed much to his success. He reserved his straw hats for the chiefs. Whenever he reached a village he would solemnly crown the chief with a hat. He would tell the chief that the hat was not only a token of his friendship, but was given to him to wear as an emblem of his rulership and as an article of attire that would distinguish him from all his subjects. The chiefs were highly pleased to be thus invested with a token of royalty, and the news of the white man's munificence spread far and wide. Every chief awaited his coming with eagerness and welcomed him with open arms.

The average width of the river is from 500 to 700 feet. Its course is very winding and the currents are so rapid that navigation is difficult. It took the party twenty-two days to ascend the stream, but they were only seven days in returning.

The river banks are quite densely populated. The natives never saw a white man before. The Languasi tribe numbers about 20,000 persons, their little farms lining the river banks with scarcely a break as far as their country extends. The men are physically fine specimens, though they disfigure their faces by making large holes in their lips or noses, in which pieces of wood or stone are inserted. Thousands of people from the Mobangi come among them to buy goats, fowls, millet, sorghum, and yams.

Mr. Séguin found that the country is rich in rubber. There is little of it near the river on account of the unfortunate practice of burning the undergrowth around the farms. But the Landolphia vine, from which a rubber is obtained, is in great abundance a few miles from the river. The Fura tribe, who are great warriors, had no idea of the value of rubber. One of their chiefs said to Mr. Séguin after he had received an object lesson in the collection of rubber and had been told that it would be much to the advantage of his people to collect rubber and sell it to the whites:

"We Fura know how to fight and how to hunt. But I can tell you one thing; we will never dirty our fingers with that sticky stuff." That was as far as his commercial education had advanced when the explorer left him.

This voyage proved that the population is dense over the large part of the river basin. Elephants are not found in the country, the only ivory the natives have for sale coming to them from other tribes. On the other hand a new and rich source of rubber has been now added to the other great Congo caoutchouc districts, and nearly all the population express perfect willingness to gather it and to open friendly relations with European traders.

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